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ABSTRACT

This curriculum guide is intended to train trade and industrial education students in the hands-on aspects of the occupation of plumber. Included in the guide are course outlines that are grouped according to the following topics: an introduction to plumbing, blueprint reading, preparation and joining of pipes, drainage and venting systems, water systems, pumps, disposal systems, installation of fixtures, heating systems, maintenance and repair, and calculation of estimates. Each course outline contains some or all of the following: a duty; a task statement; a performance objective and performance guide; suggested learning activities; a list of recommended resources; student evaluation criteria, including answers to any evaluation questions or exercises provided; a lesson test; test answers; and attachments (including handouts, forms, and transparency masters). Appendixes to the guide contain a duty and task list, definitions of terms, a tool and equipment list, a bibliography, and evaluation questions and answers. (MN)

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ED264399

V-TECS GUIDE

FOR

PLUMBING

Prepared by

Margaret R. Gregory
Project Coordinator

Robert T. Benson, Ed.D.
Technical Coordinator

SOUTH CAROLINA DEPARTMENT OF EDUCATION

Dr. Charlie G. Williams, State Superintendent of Education

Division of Instruction
Sidney B. Cooper, Deputy Superintendent

Office of Vocational Education
Dr. Moody M. Oswald, Jr., Director

South Carolina Department of Education: An Equal Opportunity Agency
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Upon completion of the writing of the Plumbing V-TECS Guide, six educators were selected to field review the materials for validity and reliability. These educators are to be commended for their thoroughness in providing their expertise in modifying and approving this guide for classroom use. The field reviewers are: Michail Bates (Rock Hill Career Center); W.E. Hawkins (Enoree Career Center); J.P. Herring (Cherokee Area Vocational Center); Ernie Morris (Oconee Vocational Center); Robert Self (Kirkland Correctional Institute); and Donald Williams (Golden Strip Career Center).

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INTRODUCTION

V-TECS guides are an extension or continuation of the V-TECS catalogs. While the V-TECS catalog is a composition of duties, tasks, performance objectives, and performance guides, it deals only with the psychomotor aspect of an occupation. It is a blueprint of an occupation. It deals only with the identification of the hands-on aspect of the occupation. It does not take into consideration such things as the background information surrounding a task, how to make inferences, generalizations and decisions from a body of knowledge, nor does it deal with attitudes, job seeking skills, safety or energy conservation practices. V-TECS guides take these aspects of teaching and learning into consideration.

Experience has shown that the art of learning can also be taught while teaching subject matter. People need to learn how to learn. V-TECS guides take into consideration how students learn and are an efficient way for instructors to assist them to learn.

V-TECS guides are centered around all three domains of learning: psychomotor, cognitive, and affective. The following is a brief explanation of each.

Psychomotor

Any manipulative skill such as tightening a nut, replacing a hubcap, sharpening a pencil, machining a key slot in a steel shaft, or replacing a SCR in a solid state control panel are examples of manipulative or psychomotor skills. Tasks such as these are identified in V-TECS catalogs. V-TECS catalogs also group tasks by duties and objectives. Each performance objective has a performance standard which must be met to prove student proficiency in the manipulative aspect of the task. The V-TECS catalog, however, does not include any suggestions on how to learn to do these tasks.

V-TECS guides are developed around psychomotor tasks which are worker oriented.

Cognitive

To perform psychomotor tasks, students must think. To tighten a nut they must know which way to turn it and when to stop turning it so that they won't strip the threads or shear the bolt off. If replacing a hubcap, there is a certain technique that may vary from one car to another. For example, start the hubcap by placing the cap in a tilted position and tapping it all the way around until it is properly seated. On a different model, it may be necessary to position the hubcap and snap it all at once. At any rate, students must think about what is being done. This is cognition or a mental activity. Cognition is what goes on in the mind about any job being done. V-TECS guides provide both the collateral knowledge and the impetus to apply cognition to psychomotor tasks.

Students gain cognition through both real and vicarious experiences. They may read, view tapes, memorize or practice a process or procedure until they are certain of it. To test their knowledge, students may be required to decide the proper procedure, method or sequence for performance. This is decision making or cognitive activity at its highest.

Cognition, then, is that process by which information is stored and used. That voice that warns one of potential dangers is cognition. Anything that goes on in the mind is cognition. Students may become the best workers in their job; but, if they fail to think a process through and apply their experience, they may become just one more statistic. It is cognition that tells them to lock and tag out the power supply to an electrical apparatus before starting to repair it. However, cognition does not apply only to safety. Good cognition or thinking can help employees do a job better and quicker. V-TECS guides provide for the cognitive aspects of learning.

Affective

Curriculum writers, supervisors, and instructors often fail to assist students in acquiring a positive attitude toward themselves, their jobs, their school, or their fellow students. V-TECS guides seek to provide assistance to the instructor in achieving this. It is difficult for the instructor to identify bits and pieces of desirable behavior for every unit and often harder yet to teach them. In this area, students might be judged as to how well they clean their work area, or whether they show up to do the job on time, or whether they must be told several times to do something. Potential employers are interested in student attitude because persons angry at themselves or uncertain of themselves are often poor workers.

A student's ability to succeed on the first job and every job thereafter depends largely on attitude. If, for example, students have the attitude of "let someone else do it," they could be in trouble. Students using V-TECS guides will have activities dealing with how to get along with other students, supervisors, or staff members in both large and small groups.

USE OF A V-TECS GUIDE

The V-TECS guide is designed to provide job-relevant tasks, performance objectives, performance guides, resources, learning activities, evaluation standards, and achievement testing in selected occupations. The V-TECS guide is also designed to be used with any teaching methods you, as an instructor, may choose. If the lecture/demonstration method is best for you, you will find sufficient help to meet your needs. If you prefer to use discussions or other methods that require student participation, you will find ample help. Regardless of which method is successful for you, a V-TECS guide can save preparation time and offer innovative methods and procedures. For example, a student may work either alone or on a team while in class and learn skills in direct relation to what is actually being done on the job. This approach also takes into consideration a student's attitudes, thinking skills, and mathematical reading skills.

The use of small groups in teaching can be helpful since many students may feel inadequate due to their lack of background information in mechanical things. Some students may also feel that they are physically incompetent or lack the necessary background experiences. A successful program (course) can provide students with a sense of security by reinforcing positive attitudes while improving their skills and subject knowledge. By allowing students to interact on a personal level, this task/learner-centered approach can achieve this. As students gain confidence and discover that they are an essential part of a team engaged in the learning-teaching process, their confidence increases. The student in this setting will also learn to work without direct supervision. In addition, use of the small-group method permits the instructor to vary instructional routines away from lecture or other full-class methods to activities for single students, pairs of students, or any number so desired.

In the V-TECS guide, you will find suggestions for specific classroom activities. These activities are not meant to restrict you or your students, but only to suggest a variety of learning activities for each task statement. Please do not feel that each student must complete all the activities.

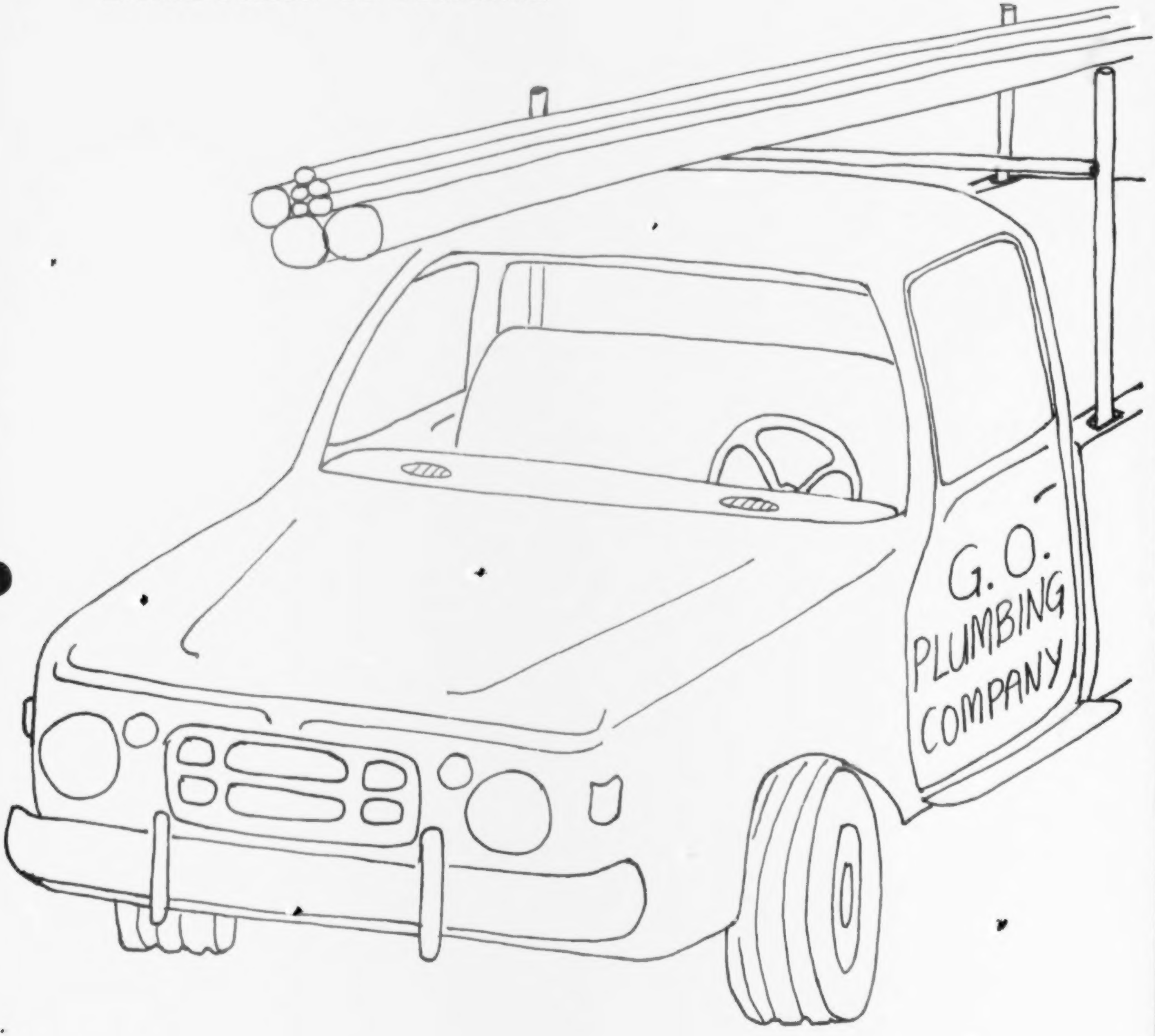
South Carolina Comments

The instructor may use the suggested teaching time as a reference point. It is an estimated amount of time for use with average students. The time allotments should in no way limit the instruction directed toward the needs of all students.

The Writing Team also recognizes that instructors will not all follow the same outline for introducing information but will eventually include the same material. This guide is developed in a sequential order with one task building upon the previous one(s). The outline may be altered, however, to allow for accessibility to equipment and difference in student abilities.

One deviation from the V-TECS catalog that the Writing Team found necessary in order to keep the consistency of the outline was to group some objectives under a duty designated differently from the V-TECS catalog and/or to change the wording of the task in order to clarify it. In these instances, the V-TECS catalog duty or task is in parentheses after the Writing Team's duty or task.

INTRODUCTION TO PLUMBING


G.O.
PLUMBING
COMPANY

Suggested teaching time
3 periods

DUTY OR UNIT: INTRODUCTION TO PLUMBING

PERFORMANCE OBJECTIVE V-TECS 1

TASK: Purpose of plumbing (list and describe)

STANDARD: The purpose and benefits of the plumbing trade must be identified and described correctly.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: Adequate reference materials

PERFORMANCE GUIDE

1. Gather information.
2. Compile information.
3. List purposes and benefits.
4. Describe purposes and benefits.

*5. Show relationship of plumbing to the health of society.

LEARNING ACTIVITIES

1. Review the history of plumbing.
2. Explain the origin of the word "plumber."
3. Identify the basic purpose of water pipes and waste pipes.
4. List some of the diseases that human wastes distribute when not properly disposed of.
5. Compare the plumbing and the public health between a modern city in the USA and one of comparable size in an underdeveloped nation.
6. Discuss the relative sanitary conditions between indoor plumbing and outhouses.
7. Arrange for the class to record their longest possible time of **not** using plumbing.

RESOURCES

Local plumbing code
Slater. **Related Information Plumbing**, pp. 1-4
Blankenbaker. **Modern Plumbing**, pp. 245-251

EVALUATION

Questions

1. When installing potable water piping, care must be taken to prevent possible ______________ ______________ which may cause disease and death.
2. What are the two major benefits of plumbing today?

Answers

1. Cross connections
2. A good supply of potable water and a safe, efficient method of disposing of fecal matter and other synthetic unsanitary wastes are the benefits of plumbing.

*Step determined to be necessary by the South Carolina Curriculum Writing Team.

Suggested teaching time
3 periods

DUTY OR UNIT: INTRODUCTION TO PLUMBING

PERFORMANCE OBJECTIVE V-TECS 2

TASK: Plumbing safety

STANDARD: Safety requirements that deal with the plumbing industry must be described correctly.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: Access to information and resources

PERFORMANCE GUIDE

1. Gather information.
2. Organize information.
3. Describe safety requirements.

LEARNING ACTIVITIES

1. Have each student button his/her shirt with one hand without the use of that thumb.
2. Emphasize the need for a safe attitude at work or play.
3. Establish a complete list of safety rules.
4. Show teacher-developed safety slides, transparencies, or posters.
5. Explain what OSHA is and why this safety program was established.
6. Discuss some of the accidents that could happen to students if safety procedures are not followed.
7. Describe how difficult it is for an individual to earn a living if he/she is permanently injured.
8. Invite a local safety supervisor to talk to the class about safety on the job.

RESOURCES

Local safety supervisor
Blankenbaker. **Modern Plumbing**, pp. 24-29
Ripka. **Plumbing Installation and Design**, pp. 13-28

EVALUATION

Questions

1. All power tools must have ______ ______ ______ type cords.
2. Safety ___________ must be worn when working with molten metals.
3. Never work higher than the second rung from the top of a ladder. (True or false)

Answers

1. Three wire grounded
2. Glasses
3. False

Suggested teaching time
2 periods

DUTY OR UNIT: INTRODUCTION TO PLUMBING

PERFORMANCE OBJECTIVE V-TECS 3

TASK: Ethics of the plumbing industry

STANDARD: The solution to a questionable situation must be satisfactory to the instructor.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: A questionable situation involving a plumber and a customer

PERFORMANCE GUIDE

1. Analyze problem situation.
2. Determine possible solution(s).
3. Present solutions to concerned parties.
4. Determine most satisfactory solution.

LEARNING ACTIVITIES

1. Discuss problems encountered when repairing a plumbing fixture in which all of the parts that needed replacing were not replaced.
2. Emphasize the need to explain to the customer all of the items that should be replaced.
3. Demonstrate how to talk to a customer who has a complaint. Emphasize the importance of attitude.
4. Explain how a customer would rather pay extra the first time than have to call the plumber for a return trip to complete the work.
5. Emphasize the need to determine if a fixture is worth repairing or needs replacing as soon as possible after starting a repair call.
6. Discuss how misuse of time on the job results in unfair prices to customers.
7. Explain how good ethics will have a beneficial long-term effect on the student's career.

RESOURCES

Local plumbing contractor
Local plumbing code
Better Business Bureau

EVALUATION

Question

Solve the following situation. A faucet has been repaired for a customer. Several weeks later the customer calls to say that it is leaking around the handle. The customer feels that the work was not completed on the first visit and the plumber should come back to finish the repair job at no extra expense. You explain that the customer only asked to have new washers and that the stem started leaking later. The customer, however, insists that you should have explained the situation in more detail and the repairs could have been made at the time. The customer is upset and you know something has to be done to keep your good reputation. What is the solution?

PERFORMANCE OBJECTIVE V-TECS 3 continued

Answer
You offer to replace the stem for material and labor only (not the trip out) and ask if this would be satisfactory. You should have informed the customer of the worn stem and any other needed repairs discovered at the time of the first visit.

Suggested teaching time
3 periods

DUTY OR UNIT: INTRODUCTION TO PLUMBING

PERFORMANCE OBJECTIVE V-TECS 4

TASK: Use of basic plumbing tools

STANDARD: The eleven basic plumbing tools and the materials used with each must be identified correctly.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: Demonstrated or referenced materials of each of the basic plumbing tools: pipe cutters, pipe dies, soldering equipment, screwdriver, pliers, wrenches (adjustable), lead pot, tubing cutters, plumb bobs, vices, digging and filling tools, pipe wrenches (8" and 24"), and extension rule (6')

PERFORMANCE GUIDE

1. Identify each tool.
2. Describe the kind of material each tool is to be used with.
*3. Demonstrate each tool.
*4. Learn the parts of each tool.

LEARNING ACTIVITIES

1. Show and identify the basic plumbing tools.
2. Explain how each tool is used.
3. Identify the types of materials each tool may be used on or with.
4. Define the parts of each tool.
5. Establish tool user safety.
6. Describe what may happen if a tool is used for the wrong purpose.

RESOURCES

Ripka. **Plumbing Installation and Design,** pp. 57-90
Blankenbaker. **Modern Plumbing,** pp. 7-23

EVALUATION

Questions

1. A plumb bob is used to measure the vertical depth of sewer inverts. (True or false)
2. Lead pots are made of ________ ________ and care should be taken not to drop them or breakage may result.
3. ________ ________ and not pliers should be used on chrome faucet parts.
4. A 24" pipe wrench is normally used on 1/2" galvanized fittings. (True or false)

Answers

1. False
2. Cast iron
3. Adjustable wrenches
4. False

*Steps determined to be necessary by the South Carolina Curriculum Writing Team.

Suggested teaching time
2 periods

DUTY OR UNIT: INTRODUCTION TO PLUMBING

PERFORMANCE OBJECTIVE V-TECS 5

TASK: Reading a rule

STANDARD: The measurement of various pipe lengths and inside sizes of pipes and fittings must be read accurately.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: Instructional demonstration and materials: 6' extension rule, pencil, and paper

PERFORMANCE GUIDE

1. Measure length of pipes set out by instructor.
2. Measure inside diameter of pipes and fittings.

LEARNING ACTIVITIES

1. Demonstrate how to handle and take care of a rule.
2. Define linear measurement.
3. Explain radius and diameter.
4. Demonstrate how to read feet and inches and fractions of an inch.
5. Draw a large scale rule on the chalkboard and identify the portions of measurement.
6. Have the students to guess:
   a. Each other's height.
   b. Distances in the workshop.
   c. Heights of workbenches and doors.
   Measure the above items and compare the results with their guesses.
7. Emphasize the need for correct measurements in a job situation.
8. Demonstrate how to convert inches to feet and inches.

RESOURCES

Slater and Smith. **Basic Plumbing,** pp. 63-67
Ripka. **Plumbing Installation and Design,** pp. 57-81
Blankenbaker. **Modern Plumbing,** pp. 7, 30-34

EVALUATION

Questions

1. How many 1/8"s are in 1"?
2. How many inches are in 2'6"?
3. There are 42" in 3' 6". (True or false)
4. Which is larger — 1/64" or 1/32"?
5. Which is less — 6'5" or 65"?

Answers

1. 8
2. 30"
3. True
4. 1/32"
5. 65"

Suggested teaching time
3 periods

DUTY OR UNIT: INTRODUCTION TO PLUMBING

PERFORMANCE OBJECTIVE V-TECS 6

TASK: Use of basic materials and fittings

STANDARD: The nine basic plumbing materials and fittings must be identified accurately.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: Demonstrations and/or instructional materials: cements, pipe dopes, solders, galvanized fittings, copper fittings, plastic fittings, cast iron fittings, clay fittings, fillers, copper pipe, galvanized pipe, plastic pipe

PERFORMANCE GUIDE

Identify and secure items presented by the instructor.

LEARNING ACTIVITIES

1. List the basic materials and fittings.
2. Describe some typical uses for each of the basic materials.
3. Demonstrate how to use and assemble the basic materials and fittings.
4. Arrange for class to visit a local supply house and view the available products.
5. Explain why some materials such as copper and steel must not be connected directly together.
6. Identify some of the areas where the basic materials and fittings should and should not be used.
7. Emphasize safety precautions needed in these specific areas.
   a. Ventilation when using plastic cements
   b. Safety glasses when soldering or pouring lead

RESOURCES

Local plumbing code
Ripka. **Plumbing Installation and Design,** pp. 29-56
Blankenbaker. **Modern Plumbing,** pp. 40-59
Slater and Smith. **Advanced Plumbing,** pp. 1-24

EVALUATION

Questions

1. ____________ connections are used to separate steel from copper.
2. Pipe dope is used to help solder flow into a copper joint. (True or false)
3. Cast-iron fittings are sometimes used on temporary installations so that they may be broken for quick dismantling. (True or false)

Answers

1. Dielectric
2. False
3. True

Suggested teaching time
3 periods

DUTY OR UNIT: INTRODUCTION TO PLUMBING

PERFORMANCE OBJECTIVE V-TECS 7

TASK: Demonstrate the use of equipment or tools.

STANDARD: Each participant in the group should operate correctly in a practice session the tool or piece of equipment as observed by the instructor.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A group setting with training aids and equipment provided

PERFORMANCE GUIDE

1. Outline uses.
2. Emphasize important features.
3. Emphasize safety measures.
4. Demonstrate storage and handling.
5. Demonstrate actual use.
6. Review Steps 1 through 4.
7. Repeat Step 5.

LEARNING ACTIVITIES

1. Explain where each tool or piece of equipment would be used.
2. Demonstrate how to carry heavy pieces of equipment.
3. Show the students how to perform preventive routine maintenance.
4. Discuss ways to prevent tool or equipment abuse.
5. Demonstrate correct usage.
6. Arrange for class to observe heavy equipment in use.

RESOURCES

Ripka. **Plumbing Installation and Design,** pp. 57-90
Blankenbaker. **Modern Plumbing,** pp. 7-23, 144-155
Local contractor
Local utility company

EVALUATION

Questions

1. When using a level on a sewer line, the bubble should be towards the low end of the level. (True or false)
2. A _________ _________ cutter uses the brittle nature of cast iron to its advantage.
3. A monkey wrench is like a pipe wrench with ___________ jaws.
4. A builder's level (transit) is used to establish _______ _______ ________.

Answers

1. False
2. Soil pipe
3. Smooth
4. Heights of piping or elevations of piping

Suggested teaching time
2 periods

DUTY OR UNIT: INTRODUCTION TO PLUMBING

PERFORMANCE OBJECTIVE V-TECS 8

TASK: Purpose of plumbing codes

STANDARD: The reasons why a plumbing code is required must include those on the instructor-developed checklist.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: Adequate reference materials

PERFORMANCE GUIDE

1. Gather information.
2. Identify major reasons for codes.
3. List major reasons for codes.
4. Describe major reason for codes.

LEARNING ACTIVITIES

1. Invite the local plumbing inspector to lecture on code requirements.
2. Arrange for class to visit the local inspection department.
3. Discuss some of the problems found in areas where plumbing codes do not exist or are not enforced.
4. Show some of the dangerous cross connection conditions that could occur in the potable water supply.
5. Describe the unsanitary conditions and enormous public health problems that would exist from poorly disposed of wastes.
6. Illustrate how bad the fishing would be from polluted rivers.
7. Explain the structural damage likely to happen in buildings due to substandard plumbing.
8. Emphasize the importance of plumbing code use relating to homeowner protection.

RESOURCES

Local plumbing code
Local plumbing inspector
National Plumbing Code

EVALUATION

Question

Identify at least three reasons for the plumbing code.

Answer

1. To insure structural soundness of buildings
2. To protect public health
3. To insure a standard of workmanship
4. Ethics

Suggested teaching time
3 periods

DUTY OR UNIT: INTRODUCTION TO PLUMBING

PERFORMANCE OBJECTIVE V-TECS 9

TASK: Uses of plumbing codes and local amendments

STANDARD: Applicable sections of the code identified and located must agree with those determined by the instructor.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: A set of job specifications and the plumbing code with local amendments

PERFORMANCE GUIDE

1. Identify job to be done.
2. Locate applicable section(s) in the latest edition of the **SBCC Plumbing Code.**
3. Locate applicable section(s) in the local amendments, if any.
4. Have instructor check your work.

LEARNING ACTIVITIES

1. Review the purpose of plumbing codes.
2. Explain how plumbing codes are established and why amendments are necessary.
3. Describe the reasons for having job specifications.
4. Discuss the problems that could occur if job specifications and plumbing codes were not followed.
5. Demonstrate how to use the plumbing code as a reference on installation methods and pipe sizes.

RESOURCES

Blankenbaker. **Modern Plumbing,** pp. 161-164
Ripka. **Plumbing Installation and Design,** pp. 1-4
Local plumbing code
National Plumbing Code

EVALUATION

Question

Which section of the plumbing code would explain the minimum size of a vent required for a water closet?

1. General regulations
2. Traps and cleanouts
3. Plumbing fixtures
4. Vents and venting

Answer

4.

BLUEPRINT READING

Suggested teaching time
3 periods

DUTY OR UNIT: BLUEPRINT READING

PERFORMANCE OBJECTIVE V-TECS 10

TASK: Identify symbols for plumbing fittings and fixtures.

STANDARD: All plumbing fittings and fixtures must be identified correctly on a blueprint provided by the instructor.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: A set of blueprints and a legend of plumbing symbols

PERFORMANCE GUIDE

1. Study legend of symbols.
2. Identify fittings and fixtures.
3. List fittings and fixtures.

LEARNING ACTIVITIES

1. Review the basic plumbing fittings.
2. Illustrate the symbols for the basic fittings.
3. Illustrate the symbols for the basic fixtures.
4. Discuss the purpose for having a standard system of recognizable symbols.
5. Identify the symbols for fixtures and fittings on an old set of blueprints.

RESOURCES

Blankenbaker. **Modern Plumbing,** pp. 90-91
National Plumbing Code
Blueprints

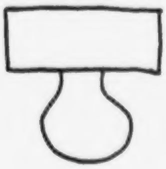
EVALUATION

Question

Draw the symbol for (1) a tank type water closet, (2) a hot water pipe, and (3) a gate valve.

Answer

1.



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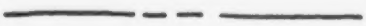

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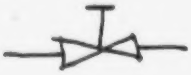


Suggested teaching time
2 periods

DUTY OR UNIT: BLUEPRINT READING

PERFORMANCE OBJECTIVE V-TECS 11

TASK: Sketch floor plan.

STANDARD: Correct symbols must be used to sketch plumbing fixtures.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: A given floor plan, including kitchen and bath

PERFORMANCE GUIDE

1. List and locate required fixtures on given plan.
2. Use proper symbols to indicate location of fixture.

LEARNING ACTIVITIES

1. Review the symbols for fittings and fixtures.
2. Explain the purpose of a floor plan.
3. Describe some areas that must be avoided when roughing in pipes in walls (i.e. windows and doors).
4. Discuss ways of arranging fixtures for ease of use and economy of space.
5. Demonstrate on the chalkboard typical layouts for kitchen and bathroom.

RESOURCES

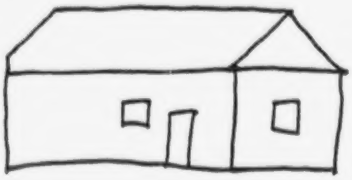
Mathias and Smith. **How to Design and Install Plumbing,** pp. 373-426
Slater and Smith. **Basic Plumbing,** pp. 46-52

EVALUATION

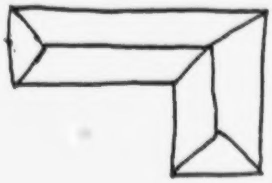
Question

Which one of the following drawings is the plan view of the house?

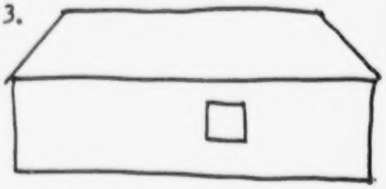
1.



2.



3.



Answer

2.

PERFORMANCE OBJECTIVE 11 CHECKLIST

SKETCH FLOOR PLAN

STUDENT'S NAME ______________ EVALUATOR'S NAME ______________

DATE ______________ DATE ______________

DIRECTIONS TO STUDENT: Sketch a floor plan including kitchen and bath. Use correct symbols for fixtures.

DIRECTIONS TO EVALUATOR: Observe the student sketching the floor plan. 90% accuracy is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Located fixtures properly		
2. Used proper symbols		
3. Used minimum fixtures		

Suggested teaching time
3 periods

DUTY OR UNIT: BLUEPRINT READING

PERFORMANCE OBJECTIVE V-TECS 12

TASK: Diagram drainage system.

STANDARD: The drainage system which is diagrammed must conform to all existing plumbing codes.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: An oblique drawing

PERFORMANCE GUIDE

1. Determine point of discharge.
2. Properly size all pipes as drawn.
3. Use a solid line for drainage; broken line for venting.
4. Show location and size of all required cleanouts.

LEARNING ACTIVITIES

1. Explain and illustrate how an oblique drawing shows depth but not true dimensions.
2. Review methods of sizing drainage pipes using the plumbing code.
3. Illustrate the solid line for drainage and broken line for venting method as used on oblique drawings.
4. Review cleanout locations.
5. Discuss how the location of the building sewer will restrict the route and elevation of the building drain.

RESOURCES

Local plumbing code
Blankenbaker. **Modern Plumbing,** pp. 92-96
National Plumbing Code
Ripka. **Plumbing Installation and Design,** pp. 144-145, 153-165
Student Information Sheet

EVALUATION

Questions

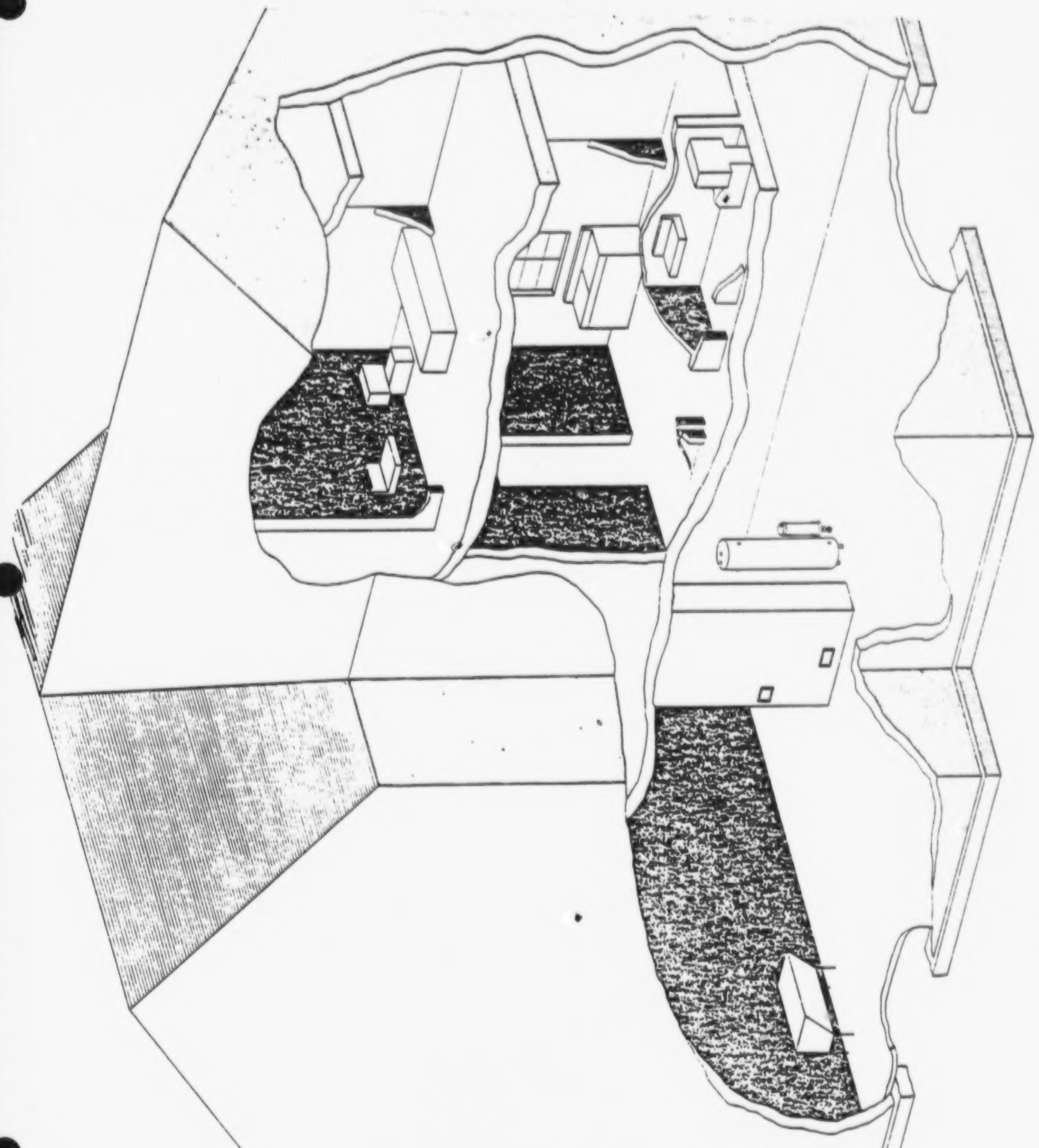
1. Why should plumbers avoid the use of "S" traps?
2. Which symbol is the vent?

a. ——— — ——— b. — — — — — — c. —————— d. — ———— —

Answers

1. "S" traps tend to induce syphonage which causes the trap to lose its water seal.
2. b

STUDENT INFORMATION SHEET



Suggested teaching time
3 periods

DUTY OR UNIT: BLUEPRINT READING

PERFORMANCE OBJECTIVE V-TECS 13

TASK: Diagram hot and cold water systems.

STANDARD: The diagrammed hot and cold water systems must conform to all existing codes.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: An oblique drawing

PERFORMANCE GUIDE

1. Determine point of entry.
2. Properly size all pipes as drawn.
3. Identify hot and cold lines with colored ink. Use red for hot and black for cold.

LEARNING ACTIVITIES

1. Explain why hot and cold water pipes are shown in different colors.
2. Discuss suitable locations for the water heater.
3. Demonstrate how to read the water pipe sizing table in the plumbing code.
4. Explain where all the necessary valves should be located.
5. Discuss suitable routes for the water piping to avoid undue damage to the building structure and also to prevent possible freezing.
6. Show how to allow for expansion and contraction of the hot water pipes.

RESOURCES

Blankenbaker. **Modern Plumbing**, p. 115
Slater and Smith. **Advanced Plumbing**, pp. 63-66
Mathias and Smith. **How to Design and Install Plumbing**, pp. 290-298
Local plumbing code
Student Information Sheet

EVALUATION

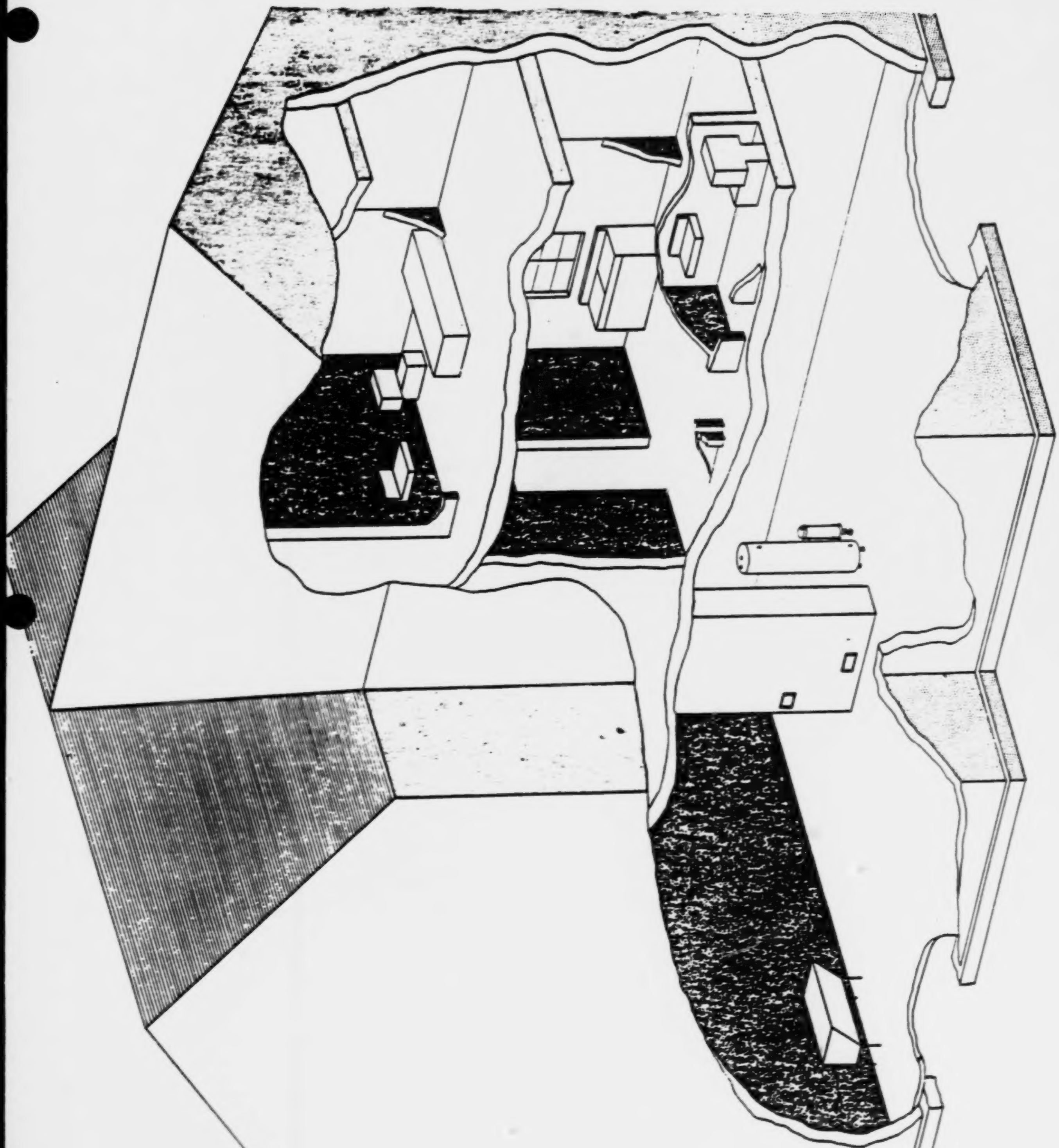
Questions

1. How much cover should a buried water service supply pipe have to protect against freezing?
2. Why must parallel hot and cold water supply pipes be several inches apart?

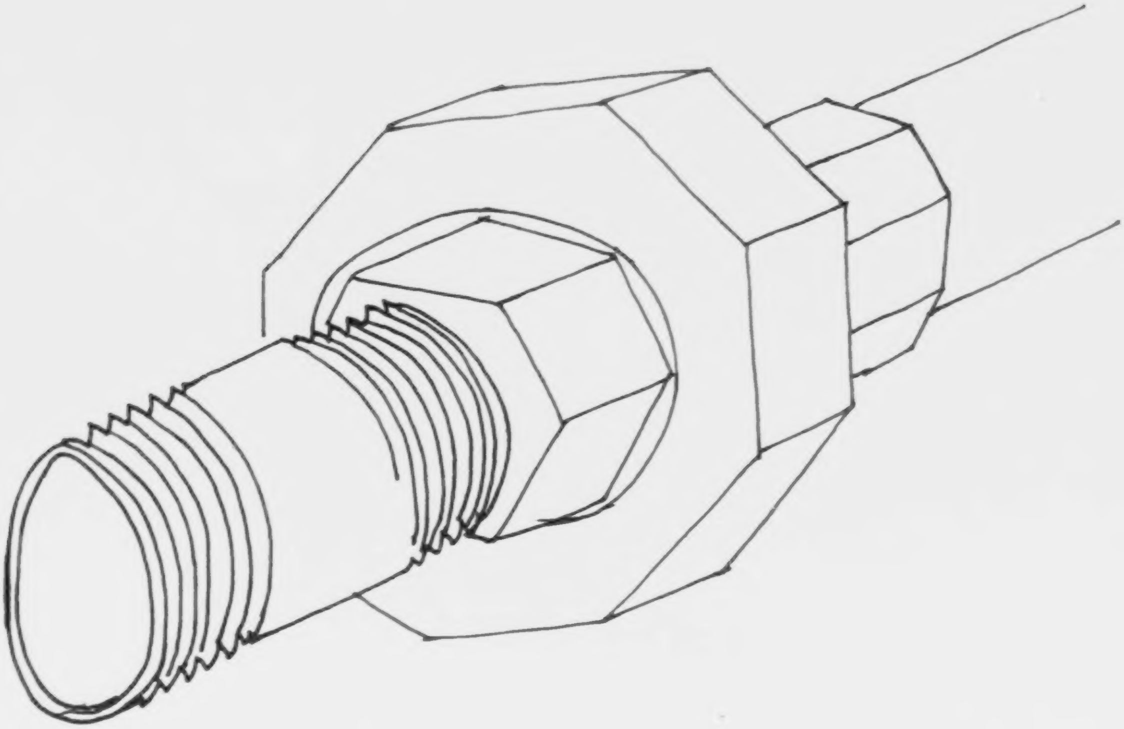
Answers

1. 18 inches for South Carolina
2. To stop heat transfer

STUDENT INFORMATION SHEET



PREPARATION AND JOINING OF PIPES



Suggested teaching time
1 period

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 14

TASK: Bend copper tubing with spring bender.

STANDARD: A tolerance of ± 3° will be allowed for the bend angle. No crimps should appear in the completed bend.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A 1/2" spring bender, a 3' section of 1/2" diameter soft copper tubing, and a flat working surface

PERFORMANCE GUIDE

1. Insert tubing into bender.
2. Clasp spring enclosed tubing with both hands--thumbs pointing inward one inch apart.
3. Form bend with thumbs and hand pressure.
4. Check bend angle.

*5. Do not overbend.

LEARNING ACTIVITIES

1. Explain the importance of using a spring bender to bend copper tubing.
2. Demonstrate correct procedure for bending tubing.
3. List types of tubing used with benders.
4. Explain manufacturing process of soft tubing.
5. Emphasize the importance of using soft tubing in plumbing.

RESOURCES

Slater and Smith. **Basic Plumbing**, pp. 133-135
Blankenbaker. **Modern Plumbing**, pp. 52-53

EVALUATION

Questions

1. Why is a spring bender used to bend copper tubing?
2. Why do we bend soft copper tubing and not hard copper tubing?
3. Name at least two types of copper tubing that can be bent with spring bender.
4. Why is it important to use correct size of spring bender on copper tubing?
5. Why is it important to form bend with thumbs and hand pressure?

Answers

1. Tubing will crink or flatten if not used.
2. Soft copper tubing is annealed and made to bend if needed.
3. Types K and L can be bent with spring bender.
4. Incorrect size will damage tubing and bender.
5. This method makes a more uniform curve in tubing.

*Step was determined to be necessary by the South Carolina Curriculum Writing Team.

PERFORMANCE OBJECTIVE V-TECS 14 continued

Practical Application
Bend a piece of copper tubing. Follow all safety precautions. Use correct copper tubing and correct spring bender with 90° angle (± 3°).

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 14 CHECKLIST

BEND COPPER TUBING WITH SPRING BENDER

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Bend copper tubing with spring bender. Fllow all safety precautions. Use correct copper tubing and correct spring bender with 90° angle (± 3°).

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to bend the tubing. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Bent pipe to 90° angle (± 3°)		
2. Properly positioned bend		
3. Did not damage pipe during bend		
4. Reamed pipe on ends		
5. Followed safety rules		
6. Activity took approximately 10 minutes		
7. Cleaned up work area and replaced tools in storage area		

Suggested teaching time
1 period

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 15

TASK: Cut cast-iron soil pipe with snap-type chain cutter.

STANDARD: The tolerance in the length will be 1/4" and the cut ends must be free of flakes. Completed work must be evaluated as acceptable.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A snap-type chain cutter and cast-iron pipe (4" diameter)

PERFORMANCE GUIDE

1. Measure and mark length to be cut.
2. Stretch chain on cutter and wrap it securely around pipe at point previously marked.
3. Lock chain cutter in place.
4. Briskly depress cutter handles until pipe falls apart.
5. Chip flakes from cut ends with a hammer. This is necessary when using gasket joints.

*6. Wear safety glasses while cutting pipe.

LEARNING ACTIVITIES

1. List types and weights of cast-iron pipe.
2. Explain manufacturing process of producing cast-iron pipe.
3. Demonstrate how to set cutter on pipe and the procedure for cutting pipe.
4. Measure correct length with rule.
5. Explain why pipe cracks easily.
6. Describe how to smooth ends of pipe.

RESOURCES

Slater and Smith. **Basic Plumbing,** pp. 77-79
Blankenbaker. **Modern Plumbing,** pp. 40-41

EVALUATION

Questions

1. Why do we cut cast-iron pipe with a snap-type cutter?
2. Why is it important to wear safety glasses while cutting pipe?
3. Describe how to set cutter on pipe.
4. Why is cast-iron easy to break or crack?
5. Why does the end of the pipe need to be square or smooth as possible?
6. Why is it important to know sizes and weights of pipe?

*Step was determined to be necessary by the South Carolina Curriculum Writing Team.

PERFORMANCE OBJECTIVE V-TECS 15 continued

Answers

1. A snap-type cutter is easy to use and efficient.
2. Metal can fly up into the eyes.
3. Follow directions on tool manual.
4. Cast iron is made of pig iron and carbon.
5. The end should be square to make water-tight joints.
6. You must be able to identify and secure the correct size of pipe.

Practical Application
Cut cast-iron pipe with snap-type chain cutter. Follow all safety rules. Check ends of pipe. Clean up area and return tools to storage area.

Method of Evaluating Practical Application
Use Checklist to determine if activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 15 CHECKLIST

CUT CAST-IRON SOIL PIPE WITH SNAP-TYPE CHAIN CUTTER

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Cut cast-iron soil pipe with snap-type chain cutter. Follow safety rules. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to cut cast-iron pipe with cutter. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Cut pipe to correct length		
2. Pipe was not broken on end		
3. Cut pipe even (square) on end		
4. Followed safety rules		
5. Completed activity in 20 minutes		
6. Demonstrated the ability to operate cutter		
7. Cleaned up work area and returned tools to storage area		

Suggested teaching time
1 period

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 16

TASK: Cut copper tubing and pipe with hacksaw.

STANDARD: A tolerance of ± 1/8" will be allowed for the cut piece. All burrs must be removed from cut ends.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A 6' folding rule, a 2' length of 3/8" diameter copper tubing, holding device, hacksaw and reamer

PERFORMANCE GUIDE

1. Measure and mark piece to be cut from tubing.
2. Secure tubing in holding device.
3. Center cutting edge of hacksaw on mark. Move hacksaw blade back and forth slowly on mark to begin cut.
4. Cut tubing with back and forth sawing action.
5. Ream cut ends.

*6. Use fine-tooth blade.
*7. Do not put a lot of pressure on saw.

LEARNING ACTIVITIES

1. List four types of copper tubing.
2. Explain how tubing is manufactured.
3. Demonstrate procedure for using holding device.
4. Explain and demonstrate correct procedure for cutting pipe.
5. Explain purpose of reaming ends of pipe.
6. Emphasize the importance of not mashing tubing.

RESOURCES

Blankenbaker. **Modern Plumbing,** pp. 52-53
Slater and Smith. **Basic Plumbing,** pp. 133-134

EVALUATION

Questions

1. Why is copper tubing placed in holding device?
2. Why is it important to follow safety rules?
3. Describe how to cut with hacksaw.
4. Why is the end of copper tubing reamed out?
5. Why are the ends of copper tubing checked?
6. Why is the stroke of the hack saw slowed down when cutting is almost finished?

*Steps were determined to be necessary by the South Carolina Curriculum Writing Team.

Answers

1. This device holds the copper tubing firmly and keeps it from bending.
2. Safety rules can prevent accidents in shop.
3. Put blade on center of mark. Move saw back and forth smoothly and evenly.
4. Reaming clears burrs and evens up the ends.
5. Check for uneven and split ends.
6. When sawing with hacksaw, the blade will cut through tubing and your hand if you don't slow down when cutting is almost finished.

Practical Application

Cut copper tubing with hacksaw. Follow safety rules. Check ends of tubing. Clean work area and replace tools in storage area.

Method of Evaluating Practical Application

Use Checklist to determine if activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 16 CHECKLIST

CUT COPPER TUBING AND PIPE WITH HACKSAW

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Cut copper tubing and pipe with hacksaw. Follow safety rules. Check ends of tubing. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to cut pipe with hacksaw. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Cut pipe to proper length (± 1/16)		
2. Reamed pipe properly 3. Did not distort or flatten pipe end		
4. Area was clean and orderly when completed		
5. Followed safety rules		
6. Completed activity in 20 minutes		

Suggested teaching time
1 period

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 17

TASK: Cut copper tubing and pipe with tubing cutter.

STANDARD: The tolerance of the length of cut will be 1/16" and the cut tubing end must be free of burrs and not flattened.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A tubing cutter and a 1' section of 1/2" diameter copper tubing

PERFORMANCE GUIDE

1. Measure and mark tubing length to be cut.
2. Place tubing cutting wheel on mark where tubing is to be cut. Slowly tighten roller against tubing.
3. Rotate cutter around circumference of tubing.
4. Tighten cutting wheel and repeat Step 3 as often as needed to complete cut.
5. Ream cut end to remove burrs.

*6. Check ends closely for uneven edges.

LEARNING ACTIVITIES

1. List types and weights of copper tubing.
2. Demonstrate complete procedure of cutting tubing.
3. Explain characteristics of copper tubing.
4. Explain the purpose of reaming ends.
5. Define parts of tubing cutter.
6. Show how to check tubing for roundness.

RESOURCES

Slater and Smith. **Basic Plumbing,** pp. 133-134
Blankenbaker. **Modern Plumbing,** pp. 52-53

EVALUATION

Questions

1. Where is the cutter wheel placed on the copper tubing when the cut is started?
2. What happens when the cutter wheel is tightened too tight?
3. Why is the end of the copper tubing reamed out?
4. Why should the ends of the copper tubing be checked?
5. Why is copper tubing cutter not used on steel pipe?

*Step was determined to be necessary by the South Carolina Curriculum Writing Team.

PERFORMANCE OBJECTIVE V-TECS 17 continued

Answers

1. Put wheel on center of mark on tubing.
2. It will mash tubing out of round.
3. Ream end to get rid of burrs in tubing.
4. Check ends of tubing for splits and out of round.
5. Using copper tubing cutter on steel pipe will damage cutter.

Practical Application

Cut copper tubing and pipe with tubing cutter. Follow safety rules. Check ends of tubing. Clean work area and replace tools in storage area.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 17 CHECKLIST

CUT COPPER TUBING AND PIPE WITH TUBING CUTTER

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Cut copper tubing and pipe with tubing cutter. Follow safety rules. Check ends of tubing. Clean work area and replace tools in storage area.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to cut with tubing cutter. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Removed all burrs		
2. Cut pipe to proper length (± 1/8")		
3. Reamed pipe properly		
4. Did work neatly		
5. Checked pipe for out-of-round		
6. Followed safety rules		
7. Area was clean and orderly when completed. Stored tools in proper place		
8. Completed work in 10 minutes		

Suggested teaching time
3 periods

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 18

TASK: Cut steel pipe with 4-wheel pipe cutter.

STANDARD: A tolerance of ± 1/8" will be allowed for the cut piece and the cut ends must be free of burrs.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A 6' folding rule, four-wheel steel pipe cutter, plumbing tools, and a length of 2 1/2" diameter steel pipe located in a trench 16" wide and 20" deep

PERFORMANCE GUIDE

1. Position pipe for cutting.
2. Measure and mark length of pipe to be cut.
3. Place pipe cutting wheels on mark to be cut.
4. Tighten cutting wheels on pipe.
5. Rotate cutter 1/4 revolution. Stop cutter, reverse 1/4 revolution, and tighten cutting wheels. Continue this sequence until cut is complete.
6. Ream inside of pipe.
7. Remove exterior burrs with file.

*8. Wear safety hat and glasses.

LEARNING ACTIVITIES

1. List types and weights of steel pipe.
2. Explain manufacturing process for producing steel pipe.
3. Explain difference between 4-wheel and 1-wheel cutters.
4. Demonstrate the entire procedure for cutting pipe.
5. Give reason for reaming pipe.
6. Explain why you have to use a 4-wheel cutter in a ditch.

RESOURCES

Slater and Smith. **Basic Plumbing**, pp. 6-7, 12
Blankenbaker. **Modern Plumbing**, pp. 15, 49

EVALUATION

Questions

1. Why is a 4-wheel cutter used in a ditch?
2. Describe how the 4-wheel cutter is operated on steel pipe in a ditch.
3. When you are working in a deep ditch, what should be done to sides of ditch?
4. Why should you wear safety glasses and helmet when cutting steel pipe in a ditch?
5. Why should the ends of the steel pipe be reamed?
6. Why should the ends of the steel pipe be inspected before and after the pipe is cut?

*Step was determined to be necessary by the South Carolina Curriculum Writing Team.

Answers

1. A 4-wheel cutter does not have to make a complete revolution to cut through pipe.
2. Rotate cutter 1/4 revolution. Stop cutter, reverse 1/4 revolution, and tighten cutting wheels. Continue this sequence until cut is complete.
3. Shore sides up with boards and planking.
4. Wear safety equipment to keep from being injured while working.
5. Ream pipe to clear all burrs out of pipe.
6. Inspect ends for splits and out of round.

Practical Application

Cut steel pipe with 4-wheel pipe cutter. Follow all safety rules. Check end of the pipe. Clean work area and store tools.

Method of Evaluating Practical Application

Use Checklist to determine if activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 18 CHECKLIST

CUT STEEL PIPE WITH 4-WHEEL PIPE CUTTER

STUDENT'S NAME	EVALUATOR'S NAME
DATE	DATE

DIRECTIONS TO STUDENT: Cut steel pipe with 4-wheel pipe cutter. Follow all safety rules. Check end of the pipe. Clean work area and store tools.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to cut steel pipe with 4-wheel pipe cutter. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Cut pipe in ditch		
2. Used pipe cutter properly		
3. Cut pipe to proper length		
4. Cut end of pipe free of burrs		
5. Kept dirt out of end of pipe		
6. Followed safety rules		
7. Cleaned up work area and returned tools to storage area		
8. Completed work in 50 minutes		

Suggested teaching time
1 period

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 19

TASK: Cut steel pipe with one wheel cutter.

STANDARD: A tolerance of ± 1/16" will be allowed for the cut piece and the cut ends must be free of burrs.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A one-wheel steel pipe cutter and a vise

PERFORMANCE GUIDE

1. Secure pipe in vise leaving approximately 6" of the end to be cut protruding from the vise.
2. Measure and mark length to be cut.
3. Place pipe cutting wheel on mark to be cut.
4. Tighten cutting wheel on pipe.
5. Make one complete revolution with pipe cutter.
6. Tighten cutting wheel, making 1/4 turn with adjustment handle or knob.
7. Continue to revolve and tighten cutting wheel until cut is completed.
8. Ream cut ends.

LEARNING ACTIVITIES

1. Demonstrate how to secure steel pipe in holding device.
2. Show how to position rollers and blade on pipe.
3. Demonstrate correct tension of one-wheel cutter.
4. Demonstrate the entire procedure of cutting steel pipe with one-wheel cutter.
5. Review reaming procedure.

RESOURCES

Slater and Smith. **Basic Plumbing,** pp. 7, 12
Blankenbaker. **Modern Plumbing,** pp. 15, 49

EVALUATION

Questions

1. Why should a one-wheel cutter not be used in a trench?
2. Describe how the one-wheel cutter is operated on steel pipe.
3. What should be done to steel pipe after cutting it?

Answers

1. You have to make a complete revolution to cut into pipe.
2. Put cutter wheel on mark, make complete revolution, and tighten cutting wheel 1/8" turn each revolution until cut is complete.
3. Ream and wipe each end.

PERFORMANCE OBJECTIVE V-TECS 19 continued

Practical Application
Cut steel pipe with one-wheel cutter. Follow all safety rules. Check end of pipe. Clean work area and store tools.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 19 CHECKLIST

CUT STEEL PIPE WITH ONE-WHEEL CUTTER

STUDENT'S NAME

EVALUTOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: Cut steel pipe with one-wheel cutter. Follow all safety rules. Check end of pipe. Clean work area and store tools.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed in order to cut pipe with one-wheel cutter. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Correctly marked pipe for cutting		
2. Tightened pipe cutter properly		
3. Cut pipe to correct length (± 1/16")		
4. Cut end of pipe free of burrs		
5. Reamed cut end of pipe properly		
6. Cleaned up work area and returned tools to storage area		
7. Completed work in 20 minutes		

Suggested teaching time
4 periods

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 20

TASK: Join cast-iron soil pipe using lead and oakum.

STANDARD: The joint must be firmly packed with oakum and filled with molten lead not less than 1 inch deep and not to extend more than 1/8 inch below the rim of the hub. The lead must be caulked tight.

SOURCE OF STANDARD: **National Standard Plumbing Code**, p. 4-2

CONDITIONS FOR PERFORMANCE OF TASK: Two 5' lengths of 4" diameter bell and spigot cast-iron soil pipe in a horizontal position, appropriate tools and supplies

PERFORMANCE GUIDE

1. Safety glasses are required.
2. Light melting furnace and heat lead.
3. Inspect bell and spigot ends to be caulked for moisture. Use dry rag to remove moisture.
4. Place spigot end of pipe into bell of other pipe.
5. Align pipe so that an equal space between pipe and hub is maintained around the circumference of joint.
6. Yarn oakum into hub with a yarning iron; then use packing iron and ball peen hammer to pack oakum tight.
7. Skim slag from molten lead.
8. Clamp joint runner around pipe.
9. Dip ladle full of molten lead from melting pot and pour lead into joint runner.
10. Allow lead to cool and remove joint runner.
11. Remove excess lead with cold chisel.
12. Using an inside caulking iron and ball peen hammer, caulk lead around pipe.
13. Using outside caulking iron and ball peen hammer, caulk lead around inside hub wall.

LEARNING ACTIVITIES

1. List the sizes and lengths of cast-iron soil pipe.
2. Explain manufacturing process for producing soil pipe.
3. Tell how to choose proper type and length of soil pipe for job.
4. List properties soil pipe is made from.
5. Emphasize safety precautions.

RESOURCES

Slater and Smith. **Basic Plumbing**, pp. 77-85
Blankenbaker. **Modern Plumbing**, pp. 40-48, 136-140

PERFORMANCE OBJECTIVE V-TECS 20 continued

EVALUATION

Questions

1. Why wear safety glasses when joining cast-iron soil pipe using lead and oakum?
2. Why should the ends be checked before joining cast-iron soil pipe?
3. What is cast-iron soil pipe made of?
4. How much space is left in hub of cast-iron soil pipe for lead?
5. Cast-iron soil pipe is used mainly for which part of plumbing system?

Answers

1. Safety glasses will protect the eyes.
2. Check ends for splits and sand holes.
3. Cast-iron soil pipe is made of pig iron and carbon in free state known as graphite.
4. One inch is left for lead.
5. It is used mainly for the drainage system.

Practical Application

Pour a lead joint on cast-iron soil pipe in a horizontal position. Follow safety rules. Check ends of pipe. Clean work area and store tools.

Method of Evaluating Practical Applications

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 20 CHECKLIST

JOIN CAST-IRON SOIL PIPE USING LEAD AND OAKUM

STUDENT'S NAME

EVALUATOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: Pour a lead joint on cast-iron soil pipe in a horizontal position. Follow safety rules. Check ends of pipe. Clean work area and store tools.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to join pipe using lead and oakum. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Centered spigot end in bell		
2. Caulked lead and oakum tight		
3. Placed lead within 1/8" from rim of hub		
4. Hub and pipe were not cracked		
5. Cleaned up work area and returned tools to storage area		
6. Completed work within 60 minutes		

Suggested teaching time
2 periods

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 21

TASK: Join cast-iron pipe to clay pipe.

STANDARD: The joint compound must be beveled smoothly around the hub of the clay pipe.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A 4" diameter cast-iron drain line 3' long, a 5' section of 6" diameter clay sewer pipe in a trench, and appropriate materials

PERFORMANCE GUIDE

1. Place appropriate size cast iron to clay pipe adapter over cast-iron spigot end.
2. Place hub of clay pipe over adapter.
3. Align pipe so that an equal clearance is maintained around circumference of joint.
4. Yarn oakum around joint, leaving a 1" cavity for wiping compound.
5. Fill remaining cavity of joint with wiping compound, rolling about 1" of additional joint compound needed for completing joint.
6. Bevel compound smoothly around hub of clay pipe.

*7. Set pipes on proper grade.

LEARNING ACTIVITIES

1. Show how to lay out trench for proper grade.
2. Tell how to choose the correct type adapter for job.
3. Explain how to select the proper joint compound.
4. Explain manufacturing process of clay pipe and cast-iron pipe.
5. List advantages and disadvantages of using clay pipe.

RESOURCES

Slater and Smith. **Basic Plumbing,** pp. 77-85, 106-107
Blankenbaker. **Modern Plumbing,** pp. 40-47, 56-57

EVALUATION

Questions

1. Why should the bottom of trench be well compacted?
2. Why is a level used on pipes?
3. What are the advantages and disadvantages of clay pipe?
4. Why is the proper grade of clay pipe important?
5. Why should the compound be beveled smoothly around hub of cast-iron and clay pipe joint?

*Step was determined to be necessary by the South Carolina Curriculum Writing Team.

PERFORMANCE OBJECTIVE V-TECS 21 continued

Answers

1. Compact bottom of trench to keep pipe from settling.
2. Use a level to get proper sewage flow.
3. The advantages of clay pipe are that it is impervious to liquids, resitant to acids, and will not corode. The disadvantages of clay pipe are that it will settle and crack easily, allowing roots to grow in pipe.
4. Use the proper grade of clay pipe so sewage will not flow too slowly or too quickly and cause the pipe to stop up.
5. This process makes a flexible, watertight joint.

Practical Application

Join two different types of pipe together in trench. Grade properly. Clean work area and replace tools to storage area.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 21 CHECKLIST

JOIN CAST-IRON PIPE TO CLAY PIPE

STUDENT'S NAME

EVALUATOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: Join two different types of pipe together in trench. Grade properly. Clean work area and replace tools in storage area.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to join cast-iron pipe to clay pipe. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Measured pipes for correct length.		
2. Measured pipes for correct diameter.		
3. Beveled joint compound smooth around hub of clay pipe.		
4. Completed job neatly.		
5. Set pipes for proper grade.		
6. Completed work within 60 minutes.		

Suggested teaching time
2 periods

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 22

TASK: Wipe clay pipe joints.

STANDARD: Equal clearance between the spigot and the bell must be maintained, and the tar compound must be beveled smoothly along the joint.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A flat surface, yarning iron, oakum, putty knife and tar compound, and 4" diameter clay pipe joint

PERFORMANCE GUIDE

1. Position pipes on flat surface.
2. Slide spigot end into pipe bell.
3. Stuff oakum between spigot and bell with yarning iron, maintaining equal clearance between exterior of the spigot and the interior of the bell. Leave 3/4" to 1" depth cavity in joint for tar compound application.
4. Fill joint cavity with tar compound — rolling approximately 1" extra material.
5. Bevel and smooth joint with hand or putty knife.

LEARNING ACTIVITIES

1. Explain manufacturing process of clay (terra cotta) pipe.
2. Show how to secure two 4-foot joints of clay pipe.
3. Explain the procedure in wiping clay pipe joints.
4. Demonstrate the procedure using the tar compound.
5. Explain the composition of tar compound and its use.

RESOURCES

Slater and Smith. **Basic Plumbing,** pp. 106-107
Blankenbaker. **Modern Plumbing,** pp. 56-57

EVALUATION

Questions

1. Why should the clay pipe be inspected for holes and splits?
2. How is terra cotta pipe made?
3. Why is the spigot centered in center of bell when joining clay pipes?
4. Why is a proper mixture of tar compound important when joining clay pipes?
5. Why should spigot be all the way up into the bell when wiping joints?

Answers

1. Some joints are cracked and will leak.
2. Terra cotta pipe is made of clay and cooked in ovens until vitrified pipe.
3. Pipe joint will be out of round and cause obstruction.
4. The mixture must be correct to seal the joint watertight.
5. This will keep oakum and compound from entering joint.

PERFORMANCE OBJECTIVE V-TECS 22 continued

Practical Application
Join two sections of clay pipe together, having equal clearance between spigot and bell. Bevel tar compound smoothly around joint. Clean the area and store the tools.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 22 CHECKLIST

WIPE CLAY PIPE JOINTS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Join two sections of clay pipe together, having equal clearance between spigot and bell. Bevel tar compound smoothly around joint. Clean work area and store tools.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to wipe clay pipe joints. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly centered pipe spigot in bell		
2. Beveled tar compound smoothly		
3. Joint is all the way up		
4. Oakum is not blocking waste flow		
5. Pipe and bell were not cracked or pitted		
6. Cleaned work area and stored tools		
7. Completed work in 45 minutes		

Suggested teaching time
1 period

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 23

TASK: Join clay pipe with couplings.

STANDARD: The completed joint must bond firmly with no leaks evident.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A joint lubricant, lubricant brush, wiping rag, Dickey-type clay pipe, and two sections of 6" diameter clay pipe

PERFORMANCE GUIDE

1. Clean pipe ends with rag.
2. Apply joint lubricant inside pipe coupling and outside bald end of pipe to be joined.
3. Place pipe coupling against bald end of pipe to be joined and press two ends together.

LEARNING ACTIVITIES

1. Demonstrate how to align pipe.
2. Emphasize the importance of keeping dirt out of coupling.
3. Show how to inspect clay pipe and coupling for splits and defects.
4. Show how to apply the lubricant.
5. Explain how to determine when joint is completed.

RESOURCES

Slater and Smith. **Basic Plumbing,** pp. 106-107
Blankenbaker. **Modern Plumbing,** pp. 56-57

EVALUATION

Question
Why is lubricant spread on inside of clay pipe coupling?

Answer
The pipe will join together more smoothly.

Practical Application
Join two sections of 6" clay pipe. Make a clean, neat joint. Clean work area and store tools properly.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 95% accuracy.

PERFORMANCE OBJECTIVE V-TECS 23 CHECKLIST

JOIN CLAY PIPE WITH COUPLINGS

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Join two sections of 6" clay pipe. Make a clean, neat joint. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials for student to join two sections of clay pipe. Observe the student. Accuracy of 95% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly cleaned pipe ends		
2. Properly lubricated joints		
3. Inserted pipe spigot to full depth of hub		
4. Joint does not leak		
5. Cleaned work area and stored tools properly		
6. Completed work within 40 minutes		

Suggested teaching time
2 periods

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 24

TASK: Join copper tubing to brass pipe.

STANDARD: The finished work will be inspected by the instructor using a leak test.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Appropriate pipe adapter, plumbing tools and materials, a situation requiring fitting copper tubing to brass tubing, 3/4" diameter copper tubing, 3/4" diameter brass pipe

PERFORMANCE GUIDE

1. Cut copper tubing to length. Ream cut end to be joined.
2. Slide copper tubing into adapter.
3. Solder joints, holding tubing with pliers while soldering and until cool.
4. Screw threaded end of brass pipe into adapter fitting and tighten.

*5. Clean the cut end and adapter with emery cloth.
*6. Apply pipe dope on threaded pipe.

LEARNING ACTIVITIES

1. Go over the characteristics of copper tubing and brass pipe.
2. Explain the uses, sizes, and weights of copper tubing and brass pipe.
3. Demonstrate how to solder copper pipe and fittings.
4. Emphasize the importance of cleaning pipe and fittings.
5. Tell how to apply the right amount of heat and solder to fittings and pipe.

RESOURCES

Slater and Smith. **Basic Plumbing**, pp. 133-136
Blankenbaker. **Modern Plumbing**, pp. 52-53

EVALUATION

Questions

1. Why is it necessary to clean copper tubing?
2. Why is flux applied to copper tubing and fittings?
3. How do you know when solder has penetrated joint?
4. Why do you need clean, sharp threads on brass pipe?

Answers

1. Clean oxidation and dirt off so that solder will stick.
2. Flux makes solder stick to tubing.
3. Solder will run into joint until full and then will drop off.
4. You need clean, sharp threads so that adapter will seat firmly and have a leak-proof joint.

*Step were determined to be necessary by the South Carolina Curriculum Writing team.

PERFORMANCE OBJECTIVE V-TECS 24 continued

Practical Application
Join 3/4" diameter copper tubing to a 3/4" diameter brass pipe. Make a clean, neat, waterproof joint. Clean work area and store tools properly.

Method of Evaluating Practical Application
Use Checklist to determine if activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 24 CHECKLIST

JOIN COPPER TUBING TO BRASS PIPE

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Join 3/4" diameter copper tubing to a 3/4" diameter brass pipe. Make a clean, neat, waterproof joint. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to join copper tubing to brass pipe. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly prepared and cleaned pipes		
2. Correctly applied flux paste and pipe compound		
3. Joint shows complete solder penetration		
4. Threaded pipe to correct depth		
5. Completed work in 50 minutes		
6. Cleaned work area and stored tools properly		

Suggested teaching time
1 period

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 25

TASK: Join copper tubing/pipe to copper pipe/tubing.

STANDARD: The joint must not leak.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Tools, equipment, supplies, two short lengths of 3/4" diameter rigid copper tubing

PERFORMANCE GUIDE

1. Ream and clean ends to be soldered.
2. Apply flux or paste to outside of tubing and inside of coupling.
3. Slide tubing ends into coupling and support assembly.
4. Apply heat evenly around fitting with oxyacetylene torch. When flux or paste bubbles out around joint, remove torch flame.
5. Apply solder to joints around fitting ends. When a line of solder shows completely around joint, connection is filled with solder.
6. Clean flux or paste and solder residue from joint.

LEARNING ACTIVITIES

1. Review characteristics of rigid copper tubing.
2. Demonstrate procedure for soldering copper tubing.
3. Emphasize importance of cleaning pipe and fittings.
4. Identify tubing, tools, and supplies needed to join copper tubing.
5. Emphasize safety precautions.

RESOURCES

Slater and Smith. **Basic Plumbing**, pp. 133-136
Blankenbaker. **Modern Plumbing**, pp. 52-53

EVALUATION

Questions

1. What tool is used to cut hard copper tubing?
2. How are the different weights of copper tubing identified?

Answers

1. Copper tubing cutter is used.
2. Color coding on the side of the pipe identifies different weights of copper tubing.

Practical Application

Join two ends together of hard copper tubing with a sweat fitting. Clean work area and store tools.

Method of Evaluating Practical Application

Use checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 25 CHECKLIST

JOIN COPPER TUBING/PIPE TO COPPER PIPE/TUBING

STUDENT'S NAME	EVALUATOR'S NAME
DATE	DATE

DIRECTIONS TO STUDENT: Join two ends together of hard copper tubing with a sweat fitting. Clean work area and store tools.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to join two ends of copper tubing. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Inserted tubing into fitting the correct distance.		
2. Removed flux and solder residue and cleaned joint.		
3. Used correct amount of solder (i.e. no runs or lumps of solder around joint).		
4. Joint does not leak.		
5. Cleaned work area and stored tools properly.		
6. Completed work within 40 minutes.		

Suggested teaching time
1 period

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 26

TASK: Join copper tubing/pipe to plastic pipe.

STANDARD: A watertight seal must be formed at the joining of the copper tubing and the plastic pipe.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A 1' length of available 1" copper tubing, a 1' length of 1" diameter plastic pipe, a copper-plastic adapter, and appropriate tools and materials

PERFORMANCE GUIDE

1. Position plastic pipe on a raised flat surface and cut to square with hacksaw.
2. Ream plastic pipe end, inside and out, with knife.
3. Clean exterior pipe end (1½" to 2") and inside of female adapter with cleaner.
4. Apply cement to cleaned pipe end.
5. Insert plastic pipe into adapter firmly against shoulder.
6. Twist pipe 1/2 turn and allow to dry.
7. Square copper tubing end with tubing cutter and ream with reamer.
8. Slide flare nut on tubing and flared tubing end.
9. Position flared tubing end to adapter and tighten flare nut to adapter.

LEARNING ACTIVITIES

1. Describe characteristics of plastic pipe.
2. Review characteristics of soft copper tubing.
3. Demonstrate how to flare copper tubing.
4. Demonstrate procedure for assembling plastic pipe and fittings.
5. List uses, sizes, and weights of copper and plastic pipe.

RESOURCES

Slater and Smith. **Basic Plumbing**, pp. 133-136
Slater and Smith. **Advanced Plumbing**, pp. 1-4
Blankenbaker. **Modern Plumbing**, pp. 52-56

EVALUATION

Questions

1. Why is it necessary to clean and square end of copper tubing?
2. Why is flare nut put on copper tubing before flaring?
3. How can you tell if end is flared correctly?
4. Why is it necessary to have clean pipe and fittings in plastic pipe?
5. Why is it necessary to twist plastic joint after assembling with glue?

Answers

1. Flared end is cleaned and squared so that it will be smooth and even.
2. It cannot be assembled after flaring.
3. The flared end will be smooth with no splits.
4. The fittings must be clean so that pipe and fittings will bond together with glue.
5. Glue will spread evenly on total area of joint.

Practical Application

Join a length of 1" diameter copper tubing to a length of 1" diameter plastic pipe. Make a clean, neat, waterproof joint. Clean work area and store tools properly.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 26 CHECKLIST

JOIN COPPER TUBING/PIPE TO PLASTIC PIPE

STUDENT'S NAME

EVALUATOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: Join a length of 1" diameter copper tubing to a length of 1" diameter plastic pipe. Make a clean, neat waterproof joint. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to join copper tubing to plastic pipe. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Cut all pipe ends square and reamed		
2. Properly made plastic joint		
3. Properly flared copper pipe, (i.e., smooth, no burrs)		
4. Joint does not leak		
5. Cleaned work area and stored tools properly		
6. Completed work within 50 minutes		

Suggested teaching time
1 period

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 27

TASK: Join copper tubing/pipe to plastic pipe, using sweat method.

STANDARD: A watertight seal as evidenced by a leak test must be formed.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Two 1' lengths of 1½" diameter pipe (one plastic and one copper), sweat adapter, materials

PERFORMANCE GUIDE

1. Clean copper pipe end and female adapter with emery cloth.
2. Apply flux or paste to copper pipe end and female adapter.
3. Insert copper pipe into adapter and twist slightly.
4. Light torch, adjust to blue flame and heat areas of copper overlap until flux or paste bubbles.
5. Apply solder and allow to cool. Remove excess solder with cloth.
6. Clean plastic pipe end and plastic section of female adapter with cleaner. Allow to dry.
7. Apply cement to plastic pipe end and inside of adapter.
8. Insert cemented pipe end into female adapter and butt firmly against adapter shoulder.
9. Twist cemented joint 1/2 turn and allow to dry.

LEARNING ACTIVITIES

1. Review characteristics of copper pipe and plastic pipe.
2. Demonstrate how to solder copper pipe and fittings.
3. Demonstrate procedure for assembling plastic pipe and fittings.
4. List the uses, sizes, and weights of copper pipe.
5. List the uses, sizes, and weights of plastic pipe.

RESOURCES

Slater and Smith. **Basic Plumbing**, pp. 133-136
Slater and Smith. **Advanced Plumbing**, pp. 1-4
Blankenbaker. **Modern Plumbing**, pp. 52-56

EVALUATION

Practical Application

Join a length of 1½" diameter copper tubing to a length of 1½" diameter plastic pipe. Make a clean, neat waterproof joint. Clean work area and store tools properly.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 27 CHECKLIST

JOIN COPPER TUBING/PIPE TO PLASTIC PIPE, USING SWEAT METHOD

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Join a length of 1½" diameter copper tubing to a length of 1½" diameter plastic pipe. Make a clean, neat, waterproof joint. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to join pipe using sweat method. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly prepared copper joint		
2. Removed excess flux and solder from joint		
3. Properly prepared plastic pipe		
4. Joint does not leak		
5. Cleaned work area and stored tools properly		
6. Completed work in 50 minutes		

Suggested teaching time
2 periods

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 28

TASK: Join copper tubing to steel pipe.

STANDARD: When subjected to a pressure test, no leaks should appear at the joint.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A 3' length of 1" diameter copper tubing, a 1' diameter threaded steel pipe 2' long, a dielectric fitting, and the proper tools and materials

PERFORMANCE GUIDE

1. Check copper tubing for square and burrs; cut and ream if necessary.
2. Disassemble dielectric fitting.
3. Clean copper tubing end and inside of female section of copper fitting with emery cloth.
4. Apply flux to cleaned areas of tubing and fitting.
5. Insert tubing end into female section of fitting and twist slightly. Tube end should rest firmly against shoulder of female section.
6. Light torch; adjust to blue flame, and heat areas of copper overlap until flux bubbles.
7. Apply solder and allow to cool. Remove excess solder and flux with cloth.
8. Apply pipe sealant to male pipe threads.
9. Attach threaded section of fitting to the pipe and tighten.
10. Reassemble fitting ends together, using wrenches in such a manner that stress on copper solder joint is avoided.

LEARNING ACTIVITIES

1. Discuss characteristics of steel pipe.
2. Demonstrate procedure for assembling steel pipe and fittings.
3. Explain purpose of using dielectric fitting to join pipes.
4. Emphasize the importance of not applying heat to plastic and rubber components of dielectric fitting.
5. Explain importance of cooling joint before applying compound dope.

RESOURCES

Slater and Smith. **Basic Plumbing**, pp. 6-7, 31-32, 133-136
Blankenbaker. **Modern Plumbing**, pp. 49-53, 144-146

EVALUATION

Questions

1. Why is it necessary to have clean, sharp threads on steel pipe?
2. Why is it necessary to use pipe joint compound on pipe threads?
3. What is the purpose of using a dielectric fitting in connection?

Answers

1. This is necessary so pipe will make up properly without leaks.
2. Pipe joint compound will lubricate threads.
3. This will keep corrosion down between different metals.

Practical Application

Join a length of copper tubing to a length of steel pipe using a dielectric fitting. Make a clean, waterproof joint. Clean work area and store tools properly.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 28 CHECKLIST

JOIN COPPER TUBING TO STEEL PIPE

STUDENT'S NAME
EVALUATOR'S NAME

DATE
DATE

DIRECTIONS TO STUDENT: Join a length of copper tubing to a length of steel pipe using a dielectric fitting. Make a clean, waterproof joint. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to join copper tubing to steel pipe. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Cut copper tubing square and reamed.		
2. Properly prepared and soldered copper tubing joint.		
3. Removed excess solder and flux.		
4. Properly prepared pipe joint (i.e., threads cleaned and sealant applied).		
5. Tightened pipe correctly (i.e., not overtightened to expand or split fitting).		
6. Joint does not leak.		
7. Cleaned work area and stored tools properly.		
8. Completed work within 50 minutes.		

Suggested teaching time
1 period

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 29

TASK: Join copper tubing with compression connectors.

STANDARD: The joint should not leak when pressure is applied.

SOURCE OF STANDARD: V-TECS Writing Team, State of Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Proper tools, two 1' sections of 1/4" diameter copper tubing, and a compression union

PERFORMANCE GUIDE

1. Square tubing ends and remove burrs, if needed.
2. Insert nut and ferrule onto end of tubing.
3. Insert tubing end into female center portion of union.
4. Position nut and ferrule and tighten with wrenches — ferrule is compressed, forming seal.
5. Repeat Steps 2, 3 and 4 for remaining side.

LEARNING ACTIVITIES

1. Demonstrate procedure for assembling compression fittings.
2. Demonstrate with adjustable wrenches how to tighten nuts.
3. Explain the use of compression fittings.
4. Explain the purpose of the brass sleeve in the compression fitting.
5. Show how to round pipe that is out-of-round.

RESOURCES

Slater and Smith. **Basic Plumbing**, pp. 133-136
Blankenbaker. **Modern Plumbing**, pp. 52-53, 57-58

EVALUATION

Questions

1. Why is it important to use adjustable wrenches on brass fittings?
2. How tight should nuts be tightened on compression fittings?
3. What keeps joint from leaking on compression fittings?

Answers

1. Adjustable wrenches have smooth jaws. Pliers or pipe wrenches will scar or break wall of nut.
2. Tighten nut medium tight. Nut will crack if it is too tight.
3. Nut compresses sleeve against tubing and seals joint.

Practical Application

Connect two sections of copper tubing by means of a compresion union. Make a clean, waterproof joint. Clean work area and store tools properly.

Method of Evaluating Practical Application

Use checklist to determine if the activity was completed with at least 95% accuracy.

PERFORMANCE OBJECTIVE 29 CHECKLIST

JOIN COPPER TUBING WITH COMPRESSION CONNECTORS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Connect two sections of copper tubing by means of a compression union. Make a clean, waterproof joint. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to join tubing with compression connectors. Observe the student. Accuracy of 95% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Reamed and squared tubing ends and removed burrs		
2. Correctly placed nuts and ferrules on tubing		
3. Properly tightened joint (i.e., tubing not distorted or twisted)		
4. Joint does not leak		
5. Cleaned work area and stored tools properly		
6. Completed work in 30 minutes		

Suggested teaching time
1 period

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 29-A

TASK: Join copper pipe using flare connectors.

STANDARD: Tubing must be joined together using the flare connectors and joint must not leak.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: Proper tools, two 1' sections of 1/4" diameter copper tubing, and a flare union

PERFORMANCE GUIDE

1. Square tubing ends. Ream and remove burrs.
2. Place flare nuts over tubing ends.
3. Flare tubing.
4. Tighten flare nuts on union using correct size wrenches.
5. Use caution so tubing is not distorted or twisted when tightening flare nuts.

LEARNING ACTIVITIES

1. Review characteristics of copper tubing.
2. Demonstrate procedure of flaring tubing.
3. Demonstrate with correct tools how to assemble.
4. Put flare nut on tubing before flaring.
5. Show how to check tubing for cracks or splits.
6. Demonstrate how tight to tighten flare nuts on flare fittings.

RESOURCES

Slater and Smith. **Basic Plumbing,** pp. 133-136
Blankenbaker. **Modern Plumbing,** pp. 52-58

EVALUATION

Questions

1. Why should you inspect copper tubing for splits or cracks?
2. Why is it important to use adjustable wrenches on flare connectors?
3. Why do you ream copper tubing?
4. Can you flare hard tubing? Why?

Answers

1. If tubing is split or rough, the joint will leak.
2. Adjustable wrenches have smooth jaws; pliers or pipe wrenches will scar nuts and mash.
3. Ream copper tubing to open the end up and smooth end for flaring.
4. No, hard tubing is not designed to flare and will split on ends.

Practical Application
Connect two sections of soft tubing by means of a flare union. Make a clean, waterproof joint. Clean work area and store tools properly.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 95% accuracy.

PERFORMANCE OBJECTIVE V-TECS 29-A CHECKLIST

JOIN COPPER PIPE USING FLARE CONNECTORS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Connect two sections of soft tubing by means of a flare union. Make a clean, waterproof joint. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to join pipe using flare connectors. Observe the student. Accuracy of 95% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Squared and reamed tubing ends and removed burrs		
2. Put flare nuts on tubing before flaring		
3. Flare is smooth and even		
4. Joint does not leak		
5. Cleaned work area and stored tools properly		
6. Completed work in 40 minutes		

Suggested teaching time
1 period

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 30

TASK: Join pipe with no-hub or band clamp couplings.

STANDARD: The pipe joint must not leak.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A plumber's tool kit, hubless cast-iron soil pipe, and a pipe support

PERFORMANCE GUIDE

1. Cut pipe ends to square, if necessary.
2. Insert pipe ends into gasket, firmly seated against center shoulder rib.
3. Secure pipe in place.
4. Position stainless steel shroud to surround and cover gasket.
5. Position band clamps.
6. Torque bands to 60 pounds. (5: 98-101)

LEARNING ACTIVITIES

1. Discuss characteristics of no-hub, cast-iron soil pipe.
2. Demonstrate cutting procedure with chain pipe cutter.
3. Review safety precautions for this procedure.
4. Emphasize importance of having smooth, square ends.
5. Demonstrate procedure for using no-hub band clamps on pipe.
6. Explain importance of having good pipe supports.

RESOURCES

Slater and Smith. **Basic Plumbing**, pp. 2-3, 77-84, 112-113
Blankenbaker. **Modern Plumbing**, pp. 24-29, 40-48, 136-142

EVALUATION

Questions

1. Why do you cut cast-iron pipe ends square?
2. Why should you wear safety glasses?
3. Why do you position stainless steel shroud to cover gasket?
4. Why should you use a torque wrench on no-hub band clamps?
5. Why is it necessary to support cast-iron pipe securely?

Answers

1. Pipe ends are cut square so pipe will be uniform and straight.
2. Pipe can break while being cut and could injure the eye.
3. It is positioned to fit squarely and eliminate leaks.
4. If tightened too tight, threads will strip and cause leaks.
5. Cast-iron is heavy and will leak in joint if moved out of place.

PERFORMANCE OBJECTIVE V-TECS 30 continued

Practical Application
Using no-hub type couplings, join 4" diameter, hubless cast-iron soil pipe. Make a watertight joint. Clean work area and store tools properly.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE 30 CHECKLIST

JOIN PIPE WITH NO-HUB OR BAND CLAMP COUPLINGS

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Using no-hub type couplings, join 4" diameter, hubless cast-iron soil pipe. Make a waterproof joint. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to join pipe with no-hub couplings. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Seated pipe firmly against center shoulder rib		
2. Stainless steel shroud surrounds and covers gasket		
3. Properly positioned and torqued clamps to 60 pounds		
4. Joint does not leak		
5. Cleaned work area and stored tools properly		
6. Completed work in 55 minutes		

Suggested teaching time
1 period

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 31

TASK: Join plastic pipe to cast-iron pipe with no-hub couplings.

STANDARD: Watertight seal must be formed and evidenced by a leak test.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Two 3' sections of 3" diameter pipe (one plastic and one cast-iron), a no-hub coupling and proper tools

PERFORMANCE GUIDE

1. Cut pipe ends to square, if necessary.
2. Align pipe ends several inches apart.
3. Insert pipe ends to center rib of no-hub gasket.
4. Position and adjust stainless steel shroud to surround and cover gasket.
5. Position clamps on both sides of rib and tighten to desired torque.

*6. Wear safety glasses when cutting pipe.

LEARNING ACTIVITIES

1. Demonstrate the installation of no-hub coupling to cast-iron to plastic pipe.
2. Explain the difference between plastic to cast-iron and regular cast-iron no-hub coupling.
3. Review reasons for centering pipes in couplings.
4. Show the differences in wall thickness in cast-iron and plastic pipe.
5. Describe the different types of plastic to cast-iron, no-hub couplings available.

RESOURCES

Slater and Smith. **Basic Plumbing,** pp. 1-3, 77-84, 112-142
Slater and Smith. **Advanced Plumbing,** pp. 1-4
Blankenbaker. **Modern Plumbing,** pp. 24-29, 40-48, 53-56, 131-133, 136-142

EVALUATION

Question

Why is it necessary to use a special coupling when joining plastic to cast-iron soil pipe?

Answer

A special coupling must be used to avoid an eccentric connection.

Practical Application

Using a no-hub type fitting, join plastic to cast-iron pipe. Make a clean, watertight joint. Clean work area and store tools properly.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

*Step was determined to be necessary by the South Carolina Curriculum Writing Team.

PERFORMANCE OBJECTIVE 31 CHECKLIST

JOIN PLASTIC PIPE TO CAST-IRON PIPE WITH NO-HUB COUPLINGS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Using a no-hub type fitting, join plastic to cast-iron pipe. Make a clean, watertight joint. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to join plastic pipe to cast-iron pipe. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Cut pipe ends square		
2. Properly inserted pipe to center rib of no-hub gasket		
3. Properly positioned stainless steel shroud to surround and cover gasket		
4. Positioned clamps and tightened to proper torque		
5. Joint does not leak		
6. Spread cement evenly in joint		
7. Cleaned work area and stored tools properly		
8. Completed work in 55 minutes		

Suggested teaching time
1 period

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 32

TASK: Join plastic pipe, using solvent cement method.

STANDARD: The finished joint must not leak.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Two 3' sections of 2" diameter PVC pipe, an appropriate adapter, plastic pipecleaner, plastic pipe cement, and brush

PERFORMANCE GUIDE

1. Check ends of pipe for square and burrs.
2. Clean pipe ends and fitting sockets with cloth, if necessary.
3. Apply pipe cleaner to outside male end of pipe and inside socket fitting.
4. Apply cement to male end of pipe and inside socket of fitting with brush.
5. Insert male end of pipe fully into socket while cement is still wet. Rotate pipe 1/2 turn.
6. Repeat Steps 3-5 for remaining end of fitting and second length of pipe.
7. Wipe off excess cement after joining each end.

*8. Work in well-ventilated area.

LEARNING ACTIVITIES

1. Review characteristics of plastic pipe.
2. Review safety rules to follow when joining plastic pipe, using solvent cement method.
3. Show how to apply pipe cleaner.
4. Demonstrate cementing pipe to fitting.
5. Emphasize the importance of clean pipe and fittings.

RESOURCES

Slater and Smith. **Basic Plumbing,** pp. 1-3
Slater and Smith. **Advanced Plumbing,** pp. 1-4
Blankenbaker. **Modern Plumbing,** pp. 24-29, 53-56, 131-133

EVALUATION

Questions

1. Why is it necessary to support plastic pipe securely?
2. Why is it necessary to inspect plastic pipe for smoothness and splits?
3. Why must plastic pipe be clean and free from dirt and grease?

Answers

1. Pipe is light and will move easily and cause joint to leak.
2. Sometimes they are out of round and split. This will cause a leak.
3. Cement will not stick to dirty pipe.

*Step was determined to be necessary by the South Carolina Curriculum Writing Team.

PERFORMANCE OBJECTIVE V-TECS 32 continued

Practical Application
Join two pieces of CPVC, ABS, or PVC pipe together using the adapter-cement method. Make a watertight joint. Clean work area and store tools properly.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE 32 CHECKLIST

JOIN PLASTIC PIPE USING SOLVENT CEMENT METHOD

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Join two pieces of CPVC, ABS, or PVC pipe together using the adapter-cement method. Make a watertight joint. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to join plastic pipe. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Squared pipe ends and removed burrs		
2. Cleaned pipe ends and fitting		
3. Applied cement to pipe and fitting		
4. Inserted pipe completely and properly into fitting		
5. Cleaned excess cement from joint		
6. Joint does not leak		
7. Cleaned work area and stored tools properly		
8. Completed work in 30 minutes		

Suggested teaching time
1 period

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 33

TASK: Join plastic pipe to steel pipe.

STANDARD: A watertight seal must be formed and evidenced by a leak test.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A 2' length of 1" diameter plastic pipe, a 2' length of 1" diameter steel pipe with threads, a female adapter, and the necessary tools and materials

PERFORMANCE GUIDE

1. Apply pipe sealant to male threads of steel pipe.
2. Attach female plastic adapter to steel pipe and tighten with wrench.
3. Clean inside of adapter and plastic pipe end with cleaner and allow to dry.
4. Apply plastic cement to inside of adapter and to outside of plastic pipe end.
5. Insert plastic pipe end into adapter; pipe end should butt firmly against adapter shoulder.
6. Twist plastic pipe 1/2 turn and allow to dry for several minutes.
7. Remove excess cement.

*8. Work in well-ventilated area.

LEARNING ACTIVITIES

1. Review characteristics of plastic pipe and fittings and of steel pipe and fittings.
2. Review safety rules to follow when joining plastic pipe to steel pipe.
3. Demonstrate assembling plastic pipe and fittings.
4. Explain reason for not tightening plastic fitting too tightly.
5. Explain why care should be taken not to drop the completed joint.

RESOURCES

Slater and Smith. **Basic Plumbing**, pp. 6-7
Slater and Smith. **Advanced Plumbing**, pp. 1-4
Blankenbaker. **Modern Plumbing**, pp. 49-56, 131-133

EVALUATION

Questions

1. What will happen if the plastic fitting is tightened on steel pipe too tightly?
2. Why do steel pipe threads need to be clean and sharp?

Answers

1. The fitting will split, causing a leak.
2. The plastic and steel pipe will not have a good connection.

*Step was determined to be necessary by the South Carolina Curriculum Writing Team.

PERFORMANCE OBJECTIVE V-TECS 33 continued

Practical Application
Join a section of plastic pipe to a section of steel pipe, using plastic-steel adapter. Make a watertight joint. Clean work area and store tools properly.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE 33 CHECKLIST

JOIN PLASTIC PIPE TO STEEL PIPE

STUDENT'S NAME

EVALUATOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: Join a section of plastic pipe to a section of steel pipe, using plastic-steel adapter. Make a watertight joint. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to join plastic pipe to steel pipe. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Tightened threaded joint properly		
2. Cleaned plastic and fitting properly		
3. Inserted plastic pipe into adapter the correct distance		
4. Removed excess plastic cement and pipe dope from joint		
5. Joint does not leak		
6. Cleaned work area and stored tools properly		
7. Completed work in 50 minutes		

Suggested teaching time
1 period

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 34

TASK: Join steel pipe to cast-iron pipe with no-hub couplings.

STANDARD: The joint must be watertight as evidenced by a leak test.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Two 3' sections of 3" diameter pipe (one steel and one cast-iron), an appropriate size stainless steel no-hub coupling, and the proper tools

PERFORMANCE GUIDE

1. Align pipe ends several inches apart.
2. Insert pipe ends to center rib of no-hub gasket.
3. Position stainless steel shroud to cover gasket.
4. Locate and tighten band clamps with torque wrench to desired torque.

LEARNING ACTIVITIES

1. Review safety rules when joining steel pipe to cast-iron pipe with no-hub couplings.
2. Demonstrate procedure for using no-hub couplings to join steel pipe to cast-iron pipe.
3. Explain importance of having good pipe supports.
4. Identify the difference in the walls of steel pipe and cast-iron pipe.
5. Emphasize importance of reaming steel pipe.

RESOURCES

Slater and Smith. **Basic Plumbing,** pp. 1-3, 6-7, 77-84, 112-113
Blankenbaker. **Modern Plumbing,** pp. 24-29, 40-52, 136-142

EVALUATION

Practical Application
Join a section of steel pipe to a section of cast-iron pipe using a no-hub coupling. Make a watertight joint. Clean work area and store tools properly.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 34 continued

JOIN STEEL PIPE TO CAST-IRON PIPE WITH NO-HUB COUPLINGS

STUDENT'S NAME

EVALUATOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: Join a section of steel pipe to a section of cast-iron pipe using a no-hub coupling. Make a watertight joint. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to join pipes with no-hub couplings. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Cut pipe ends square		
2. Fit pipe end snugly against center rib of gasket		
3. Fit stainless steel shroud properly		
4. Torqued stainless steel band properly		
5. Joint is leak proof		
6. Cleaned work area and stored tools properly		
7. Completed work in 55 minutes		

Suggested teaching time
3 periods

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 35

TASK: Thread steel pipe with adjustable die.

STANDARD: The completed threads must be free of nicks and burrs.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: An adjustable die and a table vise, 1" diameter steel pipe 3' in length

PERFORMANCE GUIDE

1. Secure pipe in vise.
2. Place round guide end of pipe die stock on pipe end to be threaded.
3. Press dies against pipe end with heel of hand. Hold hand against dies while taking short, clockwise strokes to begin thread-cutting operation.
4. Continue cutting threads until appropriate number of threads project from outside edge of dies. Keep die stock oiled during threading process.
5. Reverse threader and remove dies from threaded end of pipe.
6. Ream out bead in pipe end.

*7. Wear safety glasses.

LEARNING ACTIVITIES

1. Demonstrate pipe threading principle using threading tools.
2. Emphasize importance of clean, sharp threads.
3. Review safety rules when threading steel pipe with adjustable die.
4. Review measurements with ruler.
5. Emphasize importance of using threading oil.

RESOURCES

Slater and Smith. **Basic Plumbing,** pp. 1-3, 6-19
Blankenbaker. **Modern Plumbing,** pp. 7-29, 134-136

EVALUATION

Questions

1. Why use cutting oil on dies?
2. Why is it necessary to check dies and tools?
3. How far should the pipe be threaded?
4. Is it necessary to keep the floor clean of oil? Why?

Answers

1. Dies will overheat and tear threads on pipe.
2. Check for broken teeth and worn blades.
3. Thread pipe one or two threads beyond face of bit.
4. Yes, because the operator could slip on the oil and be injured.

*Step was determined to be necessary by the South Carolina Curriculum Writing Team.

PERFORMANCE OBJECTIVE V-TECS 35 continued

Practical Application
Thread one end of a 1" diameter steel pipe using an adjustable die and a vise, reamer, and cutting oil. Make clean sharp threads. Clean work area and store tools properly.

Method of Evaluating Practical Application
Use checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 35 CHECKLIST

THREAD STEEL PIPE WITH ADJUSTABLE DIE

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Thread one end of a 1" diameter steel pipe using an adjustable die and a vise, reamer, and cutting oil. Make clean sharp threads. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to thread pipe with adjustable die. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Reamed pipe properly		
2. Beveled pipe properly		
3. Threads are not nicked		
4. Thread length is correct		
5. Properly adjusted die		
6. Threads are clean		
7. Cleaned work area and stored tools properly		
8. Completed work within 40 minutes		

Suggested teaching time
2 periods

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 36

TASK: Thread steel pipe with non-adjustable die.

STANDARD: The completed threads must be free of nicks and burrs.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A ratchet-type, non-adjustable pipe die stock, stand-type vise and pipe threading dies to fit the pipe stock

PERFORMANCE GUIDE

1. Secure pipe in vise.
2. Place round guide end of pipe die stock on pipe and push pipe threading dies against pipe with heel of hand.
3. Exert pressure with heel of hand against pipe die stock and make several short turns in a clockwise direction to start threading action.
4. Turn handle of pipe die stock with even and steady pressure until two newly cut threads project beyond head of die. Oil pipe threading dies after every two or three downward strokes.
5. Reverse ratchet on pipe die stock. Make several short motions backward and forward with die stock to loosen burrs inside dies.
6. Turn pipe dies stock counterclockwise until pipe threading dies are free of threads. (6:95-96)

*7. Follow shop safety rules.

LEARNING ACTIVITIES

1. Review safety precautions when threading steel pipe with non-adjustable die.
2. Explain difference between an adjustable and a nonadjustable die.
3. Demonstrate pipe threading principle using threading tools.
4. Demonstrate how to file external burrs off pipe if needed.
5. Emphasize the need to use cutting oil when threading.

RESOURCES

Slater and Smith. **Basic Plumbing**, pp. 1-3, 6-19
Blankenbaker. **Modern Plumbing**, pp. 7-29, 134-136

EVALUATION

Practical Application

Thread one end of a 1" diameter steel pipe using a non-adjustable die, vise, reamer, and cutting oil. Make clean, sharp threads. Clean work area and store tools.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

*Step was determined to be necessary by the South Carolina Curriculum Writing Team.

PERFORMANCE OBJECTIVE V-TECS 36 CHECKLIST

THREAD STEEL PIPE WITH NON-ADJUSTABLE DIE

STUDENT'S NAME ____________ EVALUATOR'S NAME ____________

DATE ____________ DATE ____________

DIRECTIONS TO STUDENT: Thread one end of a 1" diameter steel pipe using a nonadjustable die, vise, reamer, and cutting oil. Make clean sharp threads. Clean work area and store tools.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to thread pipe with non-adjustable die. Observe student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly deburred pipe		
2. Properly beveled pipe		
3. Thread length is correct		
4. Threads are not chipped		
5. Threads are clean		
6. Cleaned work area and stored tools properly		
7. Completed work within 40 minutes		

Suggested teaching time
3 periods

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 37

TASK: Thread steel pipe with power-driven vise stand.

STANDARD: The completed threads must be free of nicks and burrs.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: A portable, power-driven vise stand and 2" diameter steel pipe stock

PERFORMANCE GUIDE

1. Insert pipe into chuck and tighten.
2. Place cutter on pipe and allow handle of cutter to rest against either one or both bars as required.
3. Start machine and control cutting action of cutter through handle.
4. Ream pipe in similar manner.
5. Stop machine. Start two or three threads on pipe by hand with ratchet-type dies.
6. Start machine and cut required number of threads, keeping oil on die stock until appropriate threads are cut.
7. Stop machine, push bars back, and remove dies from pipe by hand. (6:98)

*8. Follow all safety rules.

LEARNING ACTIVITIES

1. Review safety precautions for threading steel pipe with power-driven vise stand.
2. Demonstrate pipe threading principles using electric threader and tools.
3. Explain savings in using an electric threader.
4. Explain difference in hand threader and electric threader.
5. Demonstrate maintenance and care of power driven vise.

RESOURCES

Slater and Smith. **Basic Plumbing**, pp. 1-3, 6-19
Blankenbaker. **Modern Plumbing**, pp. 7-29, 134-136

EVALUATION

Practical Application

Cut, thread, and ream one end of a 2" diameter steel pipe. Make clean sharp threads. Clean work area and store tools properly.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

*Step was determined to be necessary by the South Carolina Curriculum Writing Team.

PERFORMANCE OBJECTIVE V-TECS 37 CHECKLIST

THREAD STEEL PIPE WITH POWER-DRIVEN VISE STAND

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Cut, thread, and ream one end of a 2" diameter steel pipe. Make clean sharp threads. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to thread pipe with power-driven vise stand. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Cut pipe and reamed properly.		
2. Thread length is correct.		
3. Threads are free of nicks and burrs.		
4. Cleaned work area and stored tools properly.		
5. Completed work within 40 minutes.		

Suggested teaching time
3 periods

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 38

TASK: Secure with hangers horizontal and vertical lines of pipe to masonry surfaces.

STANDARD: The correct hanger must be chosen for the selected pipe.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: An assortment of hangers, necessary tools and equipment, lengths of pipe of different kinds and sizes, and a masonry surface

PERFORMANCE GUIDE

1. Select pipe, position, and needed hanger.
2. Locate hanger points on surface.
3. Prepare surface (if needed).
4. Secure hanger or hanger section (whichever is needed) to surface.
5. Attach hanger clamp portion to pipe (if needed).
6. Hoist pipe into position for hanger acceptance.
7. Secure pipe to hanger.

*8. Follow shop safety rules.

LEARNING ACTIVITIES

1. Identify hangers and their uses.
2. Review safety precautions in securing hangers to masonry surfaces.
3. Identify tools used in securing hangers to masonry surfaces.
4. Demonstrate procedure for assembling hangers to masonry surfaces.
5. List types of masonry anchors.

RESOURCES

Slater and Smith. **Basic Plumbing**, pp. 1-3, 112-121
Blankenbaker. **Modern Plumbing**, pp. 24-29, 40-58, 138-141

EVALUATION

Questions

1. Why does a certain pipe need a certain hanger?
2. Why should you wear and use safety equipment when installing hangers?
3. Why is it important to know how to measure and use a level when installing hangers?
4. Why is it important to be able to identify the different types of anchors?

Answers

1. All hangers will not work on all types of pipe.
2. Working on ladders and overhead is dangerous.
3. You must be able to level pipes and space hangers correctly.
4. This will enable you to allow for the different kinds and types of pipes and methods of anchoring or attachment.

*Step was determined to be necessary by South Carolina Curriculum Writing Team.

Practical Application
Secure with hangers vertical and horizontal lines of pipe to masonry surfaces. Level and mount securely. Clean work area and store tools properly.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 85% accuracy.

PERFORMANCE OBJECTIVE V-TECS 38 CHECKLIST

SECURE WITH HANGERS HORIZONTAL AND VERTICAL LINES OF PIPE TO MASONRY SURFACES

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Secure with hangers vertical and horizontal lines of pipe to masonry surfaces. Level and mount securely. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Give access to tools, equipment, and materials for the student to secure the hangers to masonry surfaces. Observe the student. Accuracy of 85% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly selected hangers for each pipe and working surface		
2. Affixed hangers correctly		
3. Secured vertical pipes at 90° to the floor surface		
4. Placed overhead pipes at proper angle to the floor surface		
5. Used correct distances between hangers for pipe used		
6. Secured pipe or tubing		
7. Did work neatly		
8. Installation complies with local codes		
9. Completed work within 100 minutes		

Suggested teaching time
3 periods

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 39

TASK: Secure with hangers horizontal and vertical lines of pipe to metal surfaces.

STANDARD: The correct hanger must be chosen for the selected pipe.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: An assortment of hangers, necessary tools and equipment, lengths of pipe of different kinds and sizes, and a metal surface

PERFORMANCE GUIDE

1. Select pipe, position, and needed hanger.
2. Locate hanger points on surface.
3. Prepare surface (if needed).
4. Secure hanger or hanger section (whichever needed) to surface.
5. Attach hanger clamp portion to pipe (if needed).
6. Hoist pipe into position for hanger acceptance.
7. Secure pipe to hanger.

*8. Follow shop safety rules.

LEARNING ACTIVITIES

1. Demonstrate procedure for assembling hangers to metal surfaces.
2. Review safety precautions in securing hangers to metal surfaces.
3. Identify tools and equipment used in securing hangers to metal surfaces.
4. Identify hangers used on metal surfaces.
5. Discuss why different metals are used to make hangers.

RESOURCES

Slater and Smith. **Basic Plumbing**, pp. 1-3, 112-121
Blankenbaker. **Modern Plumbing**, pp. 24-29, 40-58, 138-141

EVALUATION

Practical Application
Secure with hangers vertical and horizontal lines of pipe to metal surfaces. Level and mount securely. Clean work area and store tools properly.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 85% accuracy.

*Step was determined to be necessary by the South Carolina Curriculum Writing Team.

PERFORMANCE OBJECTIVE V-TECS 39 CHECKLIST

SECURE WITH HANGERS HORIZONTAL AND VERTICAL LINES OF PIPE TO METAL SURFACES

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Secure with hangers vertical and horizontal lines of pipe to metal surfaces. Level and mount securely. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, materials, and equipment needed for the student to secure hangers to metal surfaces. Observe the student. Accuracy of 85% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly selected hangers for each pipe and working surface		
2. Affixed hangers correctly		
3. Secured vertical pipes at 90° to the floor surface		
4. Placed overhead pipes at proper angle to the floor surface		
5. Used correct distances between hangers for pipe used		
6. Secured pipe or tubing		
7. Did work neatly		
8. Installation complied with local codes		
9. Cleaned work area and stored tools properly		
10. Completed work within 100 minutes		

Suggested teaching time
2 periods

DUTY OR UNIT: PREPARATION AND JOINING OF PIPES

PERFORMANCE OBJECTIVE V-TECS 40

TASK: Secure with hangers horizontal and vertical lines of pipe to wood surfaces.

STANDARD: The correct hanger must be chosen for the selected pipe. Work is to be gauged by the Checklist with all items rated "yes" for satisfactory performance.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: An assortment of hangers, necessary tools and equipment, lengths of pipe of different kinds and sizes, and a wood surface.

PERFORMANCE GUIDE

1. Select pipe, position, and needed hanger.
2. Locate hanger points on surface.
3. Prepare surface (if needed).
4. Secure hanger or hanger section (whichever needed) to surface.
5. Attach hanger clamp portion to pipe (if needed).
6. Hoist pipe into position for hanger acceptance.
7. Secure pipe to hanger.

*8. Follow shop safety rules.

LEARNING ACTIVITIES

1. Review safety precautions in securing hangers to wood surfaces.
2. Identify tools and equipment used to secure hangers to wood surfaces.
3. Demonstrate procedure for assembling hangers to wood surfaces.
4. List the different types of lubricants for installing screws.
5. Explain how to size holes for receiving screws.

RESOURCES

Slater and Smith. **Basic Plumbing**, pp. 1-3, 112-121
Blankenbaker. **Modern Plumbing**, pp. 24-29, 40-58, 138-141

EVALUATION

Question

Why is it important to be able to identify the different types of anchors?

Answer

All hangers can not be used on all surfaces. Wood, metal and masonry surfaces each require specific hangers.

Practical Application

Secure with hangers vertical and horizontal lines of pipe to wood surfaces. Level and mount securely. Clean work area and store tools properly.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

*Step was determined to be necessary by the South Carolina Curriculum Writing Team.

PERFORMANCE OBJECTIVE V-TECS 40 CHECKLIST

SECURE WITH HANGERS HORIZONTAL AND VERTICAL LINES OF PIPE TO WOOD SURFACES

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

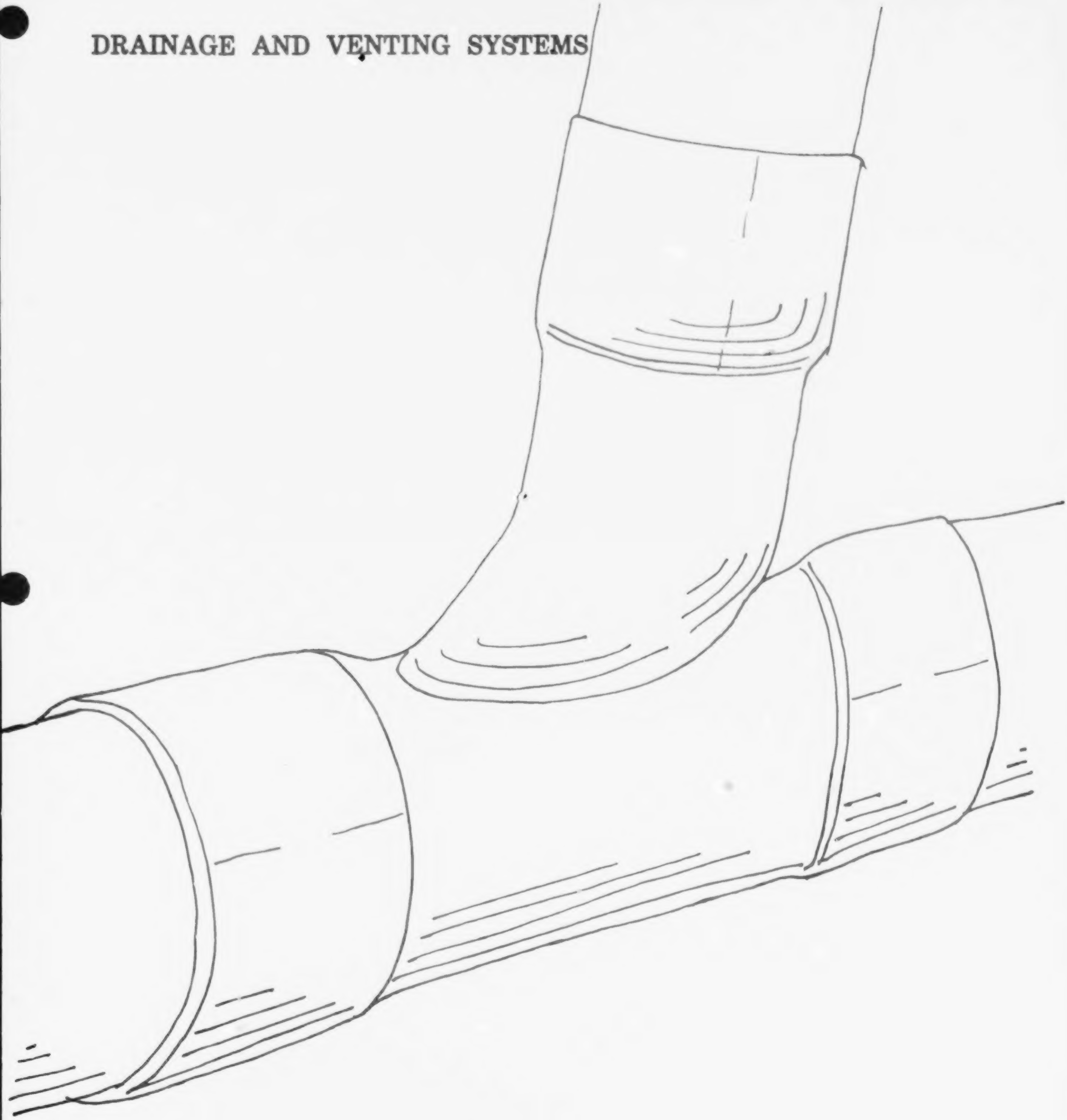
DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Secure with hangers vertical and horizontal lines of pipe to wood surfaces. Level and mount securely. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, materials, and equipment needed for the student to secure hangers to wood surfaces. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly selected hangers for each pipe and working surface		
2. Affixed hangers correctly		
3. Secured vertical pipes at 90° to the floor surface		
4. Placed overhead pipes at proper angle to the floor surface		
5. Used correct distances between hangers for pipe used		
6. Secured pipe or tubing		
7. Did work neatly		
8. Installation complies with local codes		
9. Cleaned work area and stored tools properly		
10. Completed work within 60 minutes		

DRAINAGE AND VENTING SYSTEMS



Suggested teaching time
3 periods

DUTY OR UNIT: DRAINAGE AND VENTING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 41

TASK: Calculate the slope required for building sewer lines.

STANDARD: The slope tolerance will be a minimum of 1/8" per foot of pipe. Completed work must be evaluated as acceptable.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A line level and measuring tape

PERFORMANCE GUIDE

1. Locate point where building sewer will join main sewer.
2. Pull line from stubbed sewer pipe to main sewer line and establish grade at this point.
3. Establish grade on sewer pipe stubbed out of building. The difference between grades established at main sewer and building sewer is slope required for building sewer line.

LEARNING ACTIVITIES

1. Describe what a sewer line invert is.
2. Review the correct usage of a line level and measuring tape.
3. Discuss why sewer lines should be laid at a consistent grade.
4. Explain how a nylon line will swag in the center when pulled tight and how allowance is to be made for this when used for measuring elevations of pipe inverts.
5. Demonstrate method of calculating elevation differences between two points.
6. Review use of builder's level or transit.

RESOURCES

Ripka. **Plumbing Installation and Design,** pp. 291-292, 303-306
Slater and Smith. **Basic Plumbing,** pp. 121-166
Local plumbing code
Blankenbaker. **Modern Plumbing,** pp. 121-123
Matthias and Smith. **How to Design and Install Plumbing,** pp. 56-59, 69-74

EVALUATION

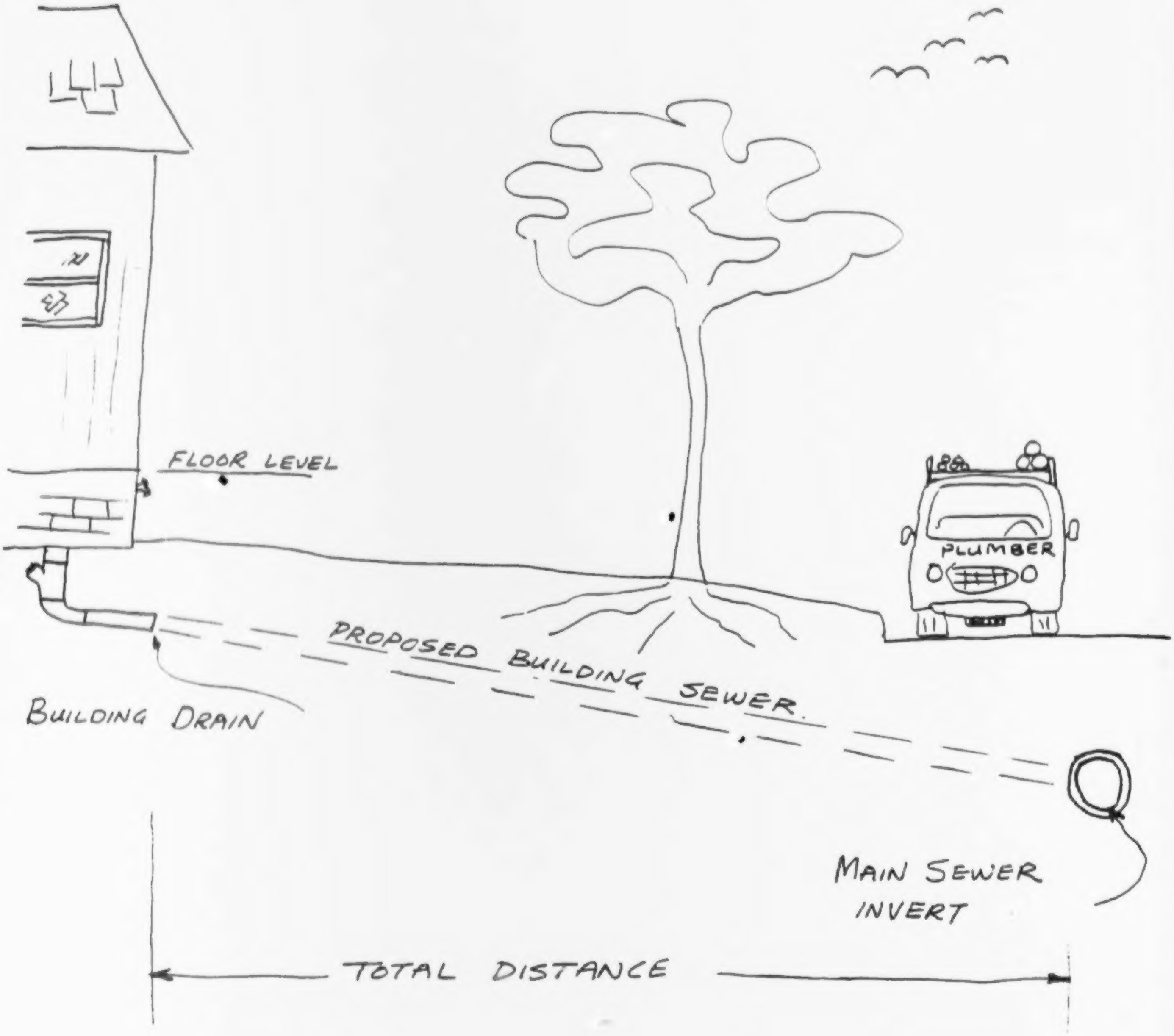
Questions

1. What is the minimum slope per foot of a four-inch building sewer?
   a. 1/16"
   b. 1/4"
   c. 1/8"
   d. 1/2"
2. When installing a building sewer the plumber should take care to insure the pipe is laid with a consistent __________ and free from __________.

Answers

1. c.
2. Slope, sags

STUDENT INFORMATION SHEET


FLOOR LEVEL
PLUMBER
PROPOSED BUILDING SEWER
BUILDING DRAIN
MAIN SEWER INVERT
TOTAL DISTANCE

PERFORMANCE OBJECTIVE V-TECS 41 CHECKLIST

CALCULATE THE SLOPE REQUIRED FOR BUILDING SEWER LINES

STUDENT'S NAME	EVALUATOR'S NAME
DATE	DATE

DIRECTIONS TO STUDENT: Using the Student Information Sheet and dimensions provided by the instructor, calculate the slope required for building sewer lines.

DIRECTIONS TO EVALUATOR: Provide the student with dimensions and the drawing needed in order to calculate the slope for the sewer lines. Observe the student's calculations for correctness. Accuracy of 95% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Length measurement is correct		
2. Slope tolerance is within limits of 1/8" per foot		

Suggested teaching time
3 periods

DUTY OR UNIT: DRAINAGE AND VENTING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 42

TASK: Install drain pipe in trenches.

STANDARD: The clay pipe in the trench must be on a grade of 1/8" per foot.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Access to tools, equipment and supplies

PERFORMANCE GUIDE

1. Determine length of sewer line.
2. Determine if minimum fall from end to end is 1/8" per foot or more.
3. Establish average grade line from end to end.
4. Lay out trench with nylon line and stakes.
5. Dig trench to desired depth, maintaining average grade (minimum 1/8" per foot).
6. Lay pipe in trench and check each length for minimum grade.
7. Join each section of pipe and clean inside joints of excess cement.
8. Test for leaks.
9. Backfill trench.
10. Observe safety practices pertaining to ditches.

LEARNING ACTIVITIES

1. Review reasons for consistent minimum grades on sewer lines.
2. Discuss methods of handling pipe to avoid breakage.
3. Review safety precautions needed when working in or around trenches.
4. Illustrate how pipes should be laid in swampy or spongy ground.
5. Demonstrate how to lay off a trench with lime or sand.
6. Explain the methods of testing a sewer.
7. Remind students that in some cases an inspector will want to see the sewer under test conditions before it is covered.

RESOURCES

Blankenbaker. **Modern Plumbing, pp. 29, 121-123**
Slater and Smith. **Basic Plumbing, pp. 162-164**
Matthias and Smith. **How to Design and Install Plumbing,** pp. 51-74
Ripka. **Plumbing Installation and Design,** pp. 303-306

EVALUATION

Questions

1. What is the condition which causes the solids to settle to the bottom of a sewer line while the liquid flows off?
2. What precautions for safety must be taken when installing pipes in unstable ground?

Answers

1. The condition is an excessive slope or pitch.
2. The ditch must be supported by bracing or shoring.

PERFORMANCE OBJECTIVE V-TECS 42 continued

Practical Application
Given access to tools, equipment, and supplies, install a drain pipe in trenches.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 42 CHECKLIST

INSTALL DRAIN PIPE IN TRENCHES

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Given access to tools, equipment, and supplies, install a drain pipe in trench according to local code. All joints must be properly cemented and cleaned. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide the student with items needed to install a drain pipe in a trench. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Provided each pipe length with proper grade of 1/8" per foot minimum.		
2. Provide entire drain line with proper grade of 1/8" per foot minimum.		
3. Installed drain pipe according to local code.		
4. Properly cemented and cleaned all joints.		
5. Drain line does not leak.		

Suggested teaching time
1 period

DUTY OR UNIT: DRAINAGE AND VENTING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 43

TASK: Backfill trenches.

STANDARD: The pipe must not be dislocated or cracked. A 3" overfill of dirt should cover the trench.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A shovel, tamp, and pipe in trench

PERFORMANCE GUIDE

1. Carefully place a 6" layer of loose dirt in trench and tamp in place.
2. Compact backfill under and beside pipe for support.
3. Place 6" layers of dirt in trench and tamp, until backfill is completed.
4. Overfill trench about 3" for settlement.

LEARNING ACTIVITIES

1. Review safety for working in trenches.
2. Explain why backfill material must be carefully placed on each side of the pipe and tamped before covering.
3. Describe why backfill material must be tamped in 6" layers.
4. Discuss tamping methods for different types of backfill material.
5. Explain how the moisture content of backfill material will affect tamping efficiency.

RESOURCES

Local plumbing code
Matthias and Smith. **How to Design and Install Plumbing**, p. 74

EVALUATION

Questions

1. Why must building sewers be carefully supported in ditches before backfilling is completed?
2. Care must be taken to prevent large ____________ from being dropped on sewer lines when backfilling is being started.

Answers

1. Building sewers must be carefully supported to prevent uneven settling of the sewer.
2. Rocks

Practical Application

Backfill trench.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 43 CHECKLIST

BACKFILL TRENCH

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Given access to tools, equipment, and materials, backfill a trench. Pipe must not be dislocated or cracked. A 3" overfill of dirt should cover the trench. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide the student with items needed to backfill a trench. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Backfilled ditch as specified		
2. Used correct tools to backfill		
3. Tamped backfill dirt as specified		
4. Overfilled ditch as specified		
5. Solid waste was not packed against pipe during backfilling operation		

Suggested teaching time
2 periods

DUTY OR UNIT: DRAINAGE AND VENTING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 44

TASK: Establish grade lines for installing plumbing.

STANDARD: Grade lines must be in accordance with local codes and partitions correctly located.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Form work for a concrete slab and construction plans

PERFORMANCE GUIDE

1. Check form work length and width for square using a 100' tape.
2. Locate plumbing walls using a blueprint.
3. Stretch nylon string at points where plumbing will be installed.
4. Review established grade lines with contractor.

LEARNING ACTIVITIES

1. Demonstrate how to check a building for "square" using a tape measure by the diagonal method.
2. Emphasize the importance of checking measurements before and after laying out partitions and trenches.
3. Explain consistency needed when performing layout measurements (i.e., all dimensions are from outside wall OR all dimensions are from center to center of walls).
4. Review methods of locating partition walls on a blueprint.
5. Demonstrate methods of anchoring nylon string to wooden stakes or brick foundations.
6. Emphasize the need to allow for finished wall thicknesses when rough-in dimensions are being calculated.

RESOURCES

Blankenbaker. **Modern Plumbing,** pp. 83-89
Ripka. **Plumbing Installation and Design,** pp. 317-319, 286-291
Oravetz. **Plumbers and Pipefitters Library,** pp. 138-150

EVALUATION

Question

When roughing-in plumbing dimensions are being calculated, allowance must be made for finished ______________ thicknesses.

Answer

Walls

PERFORMANCE OBJECTIVE V-TECS 44 continued

Practical Application
Establish grade lines for installing plumbing.

Method of Evaluating Practical Application
Use checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 44 CHECKLIST

ESTABLISH GRADE LINES FOR INSTALLING PLUMBING

STUDENT'S NAME ________ EVALUATOR'S NAME ________

DATE ________ DATE ________

DIRECTIONS TO STUDENT: Given access to tools, equipment, and materials, establish grade lines for installing plumbing. Grade lines must be in accordance with local codes and partitions must be correctly located. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide student with items needed, form work for a concrete slab, and construction plans. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Checked form work for length, width, and square		
2. Used blueprint to locate plumbing walls		
3. Used nylon string to locate plumbing points		
4. Reviewed established grade lines with contractor		
5. Allowed for finished wall thicknesses		

Suggested teaching time
2 periods

DUTY OR UNIT: DRAINAGE AND VENTING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 45

TASK: Lay out house drains.

STANDARD: The drainage system must conform to plumbing codes.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A scale, straightedge, pencil, building blueprint

PERFORMANCE GUIDE

1. Acquire manufacturer's rough-in specifications.
2. Identify location of fixtures.
3. Determine elevations and location of drain piping.
4. Determine type and size pipe required.
5. Determine type fittings for horizontal and vertical runs.
6. Lay out pipe system on the blueprint indicating pipe, sizes, elevations, and type fittings.

LEARNING ACTIVITIES

1. Discuss how heights of crawl spaces or depths of ceilings will affect methods of venting used.
2. Review the minimum pipe sizes required for individual fixtures.
3. Review the minimum slopes allowed on the basic drain pipe sizes.
4. Explain how the elevations are found.
5. Discuss the different types of fittings that could and should be used.
6. Demonstrate economical use of pipe on the blueprint.
7. Show how to check the blueprints for air conditioning ductwork and other services so these may be avoided when installing the drainage system.

RESOURCES

Blankenbaker. **Modern Plumbing,** pp. 90-93, 101-109
Local plumbing code
Ripka. **Plumbing Installation and Design,** pp. 289-292

EVALUATION

Question
When plumbing systems are being roughed in under basement floors, what precaution must be taken if that floor is below the manhole cover in the street?

Answer
A backwater valve must be installed to guard against reverse flow of sewage.

Practical Application
Lay out house drains.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 45 CHECKLIST

LAY OUT HOUSE DRAINS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Given access to blueprints and materials, lay out house drains. The drainage system must conform to plumbing codes.

DIRECTIONS TO EVALUATOR: Provide the student with the items needed to lay out house drains on a blueprint. Observe the student's drawing for correctness. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Used manufacturer's rough-in specifications		
2. Located fixtures		
3. Determined elevation and location of drain piping		
4. Indicated correct type and size of piping		
5. Used correct symbols		
6. Designed system meets plumbing code		

Suggested teaching time
2 periods

DUTY OR UNIT: DRAINAGE AND VENTING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 46

TASK: Install cleanouts on drains.

STANDARD: The cleanout must terminate at an accessible point and open in the direction of the flow of the drainage line or at right angles thereto.

SOURCE OF STANDARD: National Standard Plumbing Code, p. 5-4

CONDITIONS FOR PERFORMANCE OF TASK: 4' cast-iron cleanout plug, a drain line under construction, blueprint, and access to plumbing tools and supplies

PERFORMANCE GUIDE

1. Identify proper location of cleanout plug from construction plans.
2. Determine floor elevation or wall thickness.
3. Cut and install hub of drain pipe to accommodate cleanout placement.
4. Insert gasket in hub of drain pipe.
5. Lubricate inside of rubber gasket and outside of plug pipe.
6. Insert plug into drain hub and gasket.
7. Drive cleanout plug into drain hub and gasket, using a 2" x 4" block and hammer.

LEARNING ACTIVITIES

1. Explain the purpose of a cleanout.
2. Illustrate correct cleanout locations.
3. Discuss some poor methods of cleanout installations.
4. Explain why water closets are sometimes used in lieu of cleanouts.
5. Demonstrate measurement procedures and installation methods for cleanouts.
6. Explain why a pipe sealant-lubricant should be applied to the threads of a cleanout plug.

RESOURCES

Slater and Smith. **Basic Plumbing,** pp. 177-179
Blankenbaker. **Modern Plumbing,** p. 107
Local plumbing code

EVALUATION

Question

Cleanouts must be installed at or near the base of soil ____________ and at changes of direction greater than ______ degrees.

Answer

Stacks, 45

Practical Application

Install cleanouts on drains.

Method of Evaluating Practical Application

Use checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 46 CHECKLIST

INSTALL CLEANOUTS ON DRAINS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Given access to tools, equipment, and materials, install cleanouts on drains. The cleanout must terminate at an accessible point and open in the direction of the flow of the drainage line or at right angles thereto. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide necessary items for student to install cleanouts on drains. Observe student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly located cleanout		
2. Properly located cleanout in relation to direction of flow		
3. Properly installed cleanout		
4. Cleanout had correct elevation		

Suggested teaching time
3 periods

DUTY OR UNIT: DRAINAGE AND VENTING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 47

TASK: Rough in waste and vent lines for floor-mounted water closets.

STANDARD: The waste and vent lines must be roughed in for a floor-mounted water closet. Joints must not leak. Vents and drain lines must be properly graded and installed according to local codes.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Provide manufacturer's rough-in instructions and access to plumbing tools, equipment, and supplies. The stubbed-out waste line must be located within 1/2" of the manufacturer's specifications.

PERFORMANCE GUIDE

1. Lay out waste and vent lines using the rough-in specifications.
2. Cut pipe to length as required during installation.
3. Assemble pipe in place, leaving cleanout and vent openings.
4. Set closet collar around waste using caulk joint.
5. Locate roof position for vent pipe.
6. Cut or form vent pipe hole.
7. Connect vent pipe section from waste line through roof.

LEARNING ACTIVITIES

1. Explain the purposes of venting water closets.
2. Illustrate methods of venting water closets.
3. Review the minimum and acceptable maximum slopes of water closet soil pipes.
4. Demonstrate how to locate and cut out vent pipe terminal hole in roof.
5. Review methods of supporting horizontal and vertical soil and vent pipes.
6. Show minimum sized vents for water closets.
7. Demonstrate installing the floor flange.
8. Review how to find rough-in dimensions from manufacturer's specifications.

RESOURCES

Blankenbaker. **Modern Plumbing**, pp. 97-110, 126-131
Local plumbing code
National Plumbing Code
Oravetz. **Plumbers and Pipefitters Library**, pp. 146-160
Manufacturer's specifications

EVALUATION

Question
Why is it necessary to secure water closet floor flanges to the floor?

Answer
The flanges must be secured to prevent movement of the water closet after installation.

PERFORMANCE OBJECTIVE V-TECS 47 continued

Practical Application
Rough in waste and vent lines for floor-mounted water closets.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 47 CHECKLIST

ROUGH IN WASTE AND VENT LINES FOR FLOOR-MOUNTED WATER CLOSETS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Given access to tools, equipment, and supplies, rough in waste and vent lines for floor-mounted water closet according to local codes. Joint must not leak. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide student with items needed. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Laid out waste and vent lines according to rough-in specifications		
2. Positioned floor flange at proper height in relation to final floor level		
3. Correctly installed proper size air vent		
4. Correctly positioned and secured floor flange		

Suggested teaching time
3 periods

DUTY OR UNIT: DRAINAGE AND VENTING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 48

TASK: Rough in waste lines for wall-mounted urinals.

STANDARD: Finished work must meet fixture manufacturer's specifications.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Rough-in specifications and access to plumbing tools, equipment, and supplies

PERFORMANCE GUIDE

1. Determine drain line location.
2. Lay out plumbing from main line to fixture.
3. Assemble 2" cast-iron line and combination Y and eighth bend.
4. Set fixture line and connect to main drain.
5. Connect line from eighth bend up through slab level.
6. Connect tapped tee to open at urinal trap level.
7. Connect galvanized pipe out of tapped tee through wall.
8. Connect vent line out of tee to desired location.
9. Install cleanout at Y if urinal mounted on exterior wall.

LEARNING ACTIVITIES

1. Explain how measurements are taken from manufacturer's specifications.
2. Review the minimum slopes required for urinal drains.
3. Demonstrate installation procedures of urinal waste and vent pipes.
4. Review methods of anchoring waste pipes.
5. Explain how a urinal may "air lock" in its trap while being flushed if bad methods of venting are used.

RESOURCES

Ripka. **Plumbing Installation and Design,** pp. 210-214
Matthias and Smith. **How to Design and Install Plumbing,** pp. 365-369
Local plumbing code
Oravetz. **Plumbers and Pipefitters Library,** pp. 282-285

EVALUATION

Question
Urinals may be installed in a combination waste and vent system. (True or false)

Answer
False

Practical Application
Rough in waste lines for wall-mounted urinals.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 48 CHECKLIST

ROUGH IN WASTE LINES FOR WALL-MOUNTED URINALS

STUDENT'S NAME ________________ EVALUATOR'S NAME ________________

DATE ________________ DATE ________________

DIRECTIONS TO STUDENT: Given access to tools, equipment, and materials, rough in waste lines for wall-mounted urinal according to specifications. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide items for student to rough in waste lines. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Made drain opening for fixture within ± 1/2" of requirements		
2. Joints are leakproof		
3. Drain line has a grade of at least 1/4" per foot		
4. Properly installed vent		
5. Secured urinal to wall		

Suggested teaching time
3 periods

DUTY OR UNIT: DRAINAGE AND VENTING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 49

TASK: Rough in waste lines and vents for bathtubs.

STANDARD: Finished work must meet fixture manufacturer's specifications.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Fixture manufacturer's specifications, needed tools and supplies, and bathtub

PERFORMANCE GUIDE

1. Take measurements from rough-in specifications.
2. Lay out waste line from main line or from foundation wall to fixture.
3. Cut pipe to length.
4. Assemble pipe leaving cleanout and vent openings as necessary.
5. Align and support pipe.
6. Insert foam cup for waste line at tub drain, if installing waste in concrete slab.
7. Run vent line from soil pipe to revent line or through roof.

LEARNING ACTIVITIES

1. Illustrate methods of venting bathtub wastes.
2. Show how to take measurements from manufacturer's specifications.
3. Describe methods of "boxing" or covering waste pipes installed in concrete slabs for ease of trap assembly when the tub is set.
4. Review minimum pipe sizes and slopes required for bathtub wastes.
5. Demonstrate bathtub drain installation.
6. Review minimum size for waste pipes installed under a concrete slab.

RESOURCES

Blankenbaker. **Modern Plumbing**, p. 94
Ripka. **Plumbing Installation and Design**, pp. 171-173
Matthias and Smith. **How to Design and Install Plumbing**, pp. 346-351
Local plumbing code

EVALUATION

Question

What is the maximum vertical distance allowed between the bathtub waste outlet and the "P" trap?

1. Two feet
2. Twelve inches
3. Three feet
4. Four feet

Answer

1.

PERFORMANCE OBJECTIVE V-TECS 49 continued

Practical Application
Rough in waste lines and vents for bathtubs.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 49 CHECKLIST

ROUGH IN WASTE LINES AND VENTS FOR BATHTUBS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Given access to tools, equipment, and supplies, rough in waste lines and vents for bathtub according to manufacturer's specifications. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide items for student to rough in waste lines and vents. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Vented waste line according to code		
2. Properly located cleanout plugs		
3. Properly aligned and supported pipes		
4. Used proper pipe materials and fittings		
5. Joints did not leak when tested		

Suggested teaching time
3 periods

DUTY OR UNIT: DRAINAGE AND VENTING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 50

TASK: Rough in waste lines for shower baths.

STANDARD: Joints must not leak. Vent and waste lines must be properly graded.

SOURCE OF STANDARD: V-TECS writing team, Mississipi

CONDITIONS FOR PERFORMANCE OF TASK: Provide manufacturer's rough-in specifications and access to plumbing tools, equipment and supplies, and shower bath. The stubbed-out waste opening must be located within + 1/2" of the manufacturer's specifications.

PERFORMANCE GUIDE

1. Lay out drain and vent lines using rough-in measurements.
2. Cut pipe to length.
3. Join P-trap and Y fitting.
4. Set P-trap assembly and join to main drain line.
5. Connect vent line from Y to revent.
6. Connect shower drain to P-trap.
7. Cover drain cover to protect from obstructions.

LEARNING ACTIVITIES

1. Explain the differences between fiberglass and ceramic tile shower baths.
2. Demonstrate how to install waterproof membranes for ceramic tile shower baths.
3. Discuss methods of installing shower drains and vents.
4. Emphasize the importance of covering drainage holes to keep out construction debris.
5. List different sizes available in manufactured shower baths.

RESOURCES

Ripka. **Plumbing Installation and Design**, pp. 220-221
Blankenbaker. **Modern Plumbing**, p. 173
Matthias and Smith. **How to Design and Install Plumbing**, pp. 354-357

EVALUATION

Question
What is the purpose of the waterproof membrane under a ceramic tile shower bath?

Answer
The purpose is to catch any water that leaks through the grout joints and carry it to the drain.

Practical Application
Rough in waste lines for shower baths.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 50 CHECKLIST

ROUGH IN WASTE LINES FOR SHOWER BATHS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Given access to tools, equipment, and materials, rough in waste lines for a shower bath. Joints must not leak. Vent and waste lines must be properly graded. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide student with items needed to rough in the waste lines for a shower bath. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Waste openings were within ± 1/2" of manufacturer's specifications		
2. Properly aligned, graded and supported pipes		
3. Properly assembled all joints		
4. Joints do not leak		
5. Covered drain for protection		

Suggested teaching time
2 periods

DUTY OR UNIT: DRAINAGE AND VENTING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 51

TASK: Rough in waste lines and vents for built-in lavatories.

STANDARD: Joints must not leak. Vent and drain lines must be properly graded and installed according to local codes.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Provide fixture manufacturer's specifications. The stubbed-out waste line must be within ± 1/2" of the manufacturer's specifications.

PERFORMANCE GUIDE

1. Lay out waste line from main line to fixture.
2. Measure and cut piping for rough-in plumbing.
3. Assemble piping using no-hub couplings.
4. Attach 2" x 1 1/4" sanitary tee to assembly end.
5. Join 1 1/4" galvanized pipe, using tapped tee for connection.
6. Align and support pipe.
7. Run vent line from soil pipe to revent line, or through roof.

LEARNING ACTIVITIES

1. Show how to take measurements from manufacturer's specifications.
2. Illustrate methods of venting lavatories.
3. Explain how drainage fixture units are based on the discharge rate of a lavatory with a 1 ¼" waste outlet.
4. Demonstrate methods of marking and drilling holes for lavatory waste pipes. Emphasize safety requirements.
5. Review methods of supporting pipes.

RESOURCES

Blankenbaker. **Modern Plumbing,** pp. 106-109, 130, 166-170
Ripka. **Plumbing Installation and Design,** pp. 214-217
Local plumbing code

EVALUATION

Question
What is the drainage fixture unit discharge rating of a lavatory?

Answer
The rating is one d.f.u.

Practical Application
Rough in waste lines and vents for built-in lavatory.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 51 CHECKLIST

ROUGH IN WASTE LINES AND VENTS FOR BUILT-IN LAVATORY

STUDENT'S NAME	EVALUATOR'S NAME
DATE	DATE

DIRECTIONS TO STUDENT: Given access to tools, equipment and supplies, rough in waste lines and vents for a built-in lavatory. Joints must not leak. Installation must be according to local codes. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide student with items needed to rough in waste lines and vents for the lavatory. Observe student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Correctly laid waste line out from main line to fixture.		
2. Used no-hub couplings.		
3. Used correct size and type of tee and pipe.		
4. Stubbed waste line in within ± 1/2" of manufacturer's specifications.		
5. Joint does not leak.		
6. Installed all lines according to local code.		

Suggested teaching time
2 periods

DUTY OR UNIT: DRAINAGE AND VENTING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 52

TASK: Rough in waste lines and vents for washer.

STANDARD: Joints must not leak. Vent and drain lines must be properly graded and installed according to local codes.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Provide fixture manufacturer's specifications. The stubbed-out waste line must be within ± 1/2" of the manufacturer's specifications.

PERFORMANCE GUIDE

1. Lay out waste line from main line to fixture.
2. Measure and cut piping for rough-in plumbing.
3. Assemble piping using no-hub couplings.
4. Attach 2" sanitary tee to assembly end.
5. Join galvanized pipe using tapped tee for connection.
6. Align and support pipe.
7. Run vent line from soil pipe to revent line, or through roof.
8. Install P-trap to code specifications.

LEARNING ACTIVITIES

1. Explain why the minimum size for a washing machine waste is 2".
2. Demonstrate how to connect the waste pipe riser to a manufactured washing machine box.
3. Illustrate how to install the P-trap and piping in the wall.
4. Discuss the minimum suitable height of the waste pipe riser from its trap for effective drainage.
5. Review venting methods for washing machine wastes.

RESOURCES

Local plumbing code
Blankenbaker. **Modern Plumbing,** pp. 100-110

EVALUATION

Question
What is the minimum size waste pipe for a washing machine?

Answer
2"

Practical Application
Rough in waste lines and vents for washer.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 52 CHECKLIST

ROUGH IN WASTE LINES AND VENTS FOR WASHER

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Given access to tools, equipment, and supplies, rough in waste lines and vents for a washer according to local codes. Joints must not leak. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide student with items needed to rough in waste lines and vents for a washer. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Correctly laid out waste line mainline to fixture		
2. Used no-hub couplings		
3. Used proper size and type tee and pipe		
4. Properly aligned and supported pipe		
5. Used stand pipe of proper height		
6. Vented piping properly		
7. Lines do not leak		
8. Installed lines according to local code		

Suggested teaching time
2 periods

DUTY OR UNIT: DRAINAGE AND VENTING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 53

TASK: Rough in waste lines and vents for kitchen sink.

STANDARD: Joints must not leak. Vent and drain lines must be properly graded and installed according to local codes.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Provide fixture manufacturer's specifications, tools, equipment, kitchen sink, and a kitchen situation. The stubbed-out waste line must be within ± 1/2" of the manufacturer's specifications.

PERFORMANCE GUIDE

1. Lay out waste line from main line to fixture.
2. Measure and cut piping for rough-in plumbing.
3. Assemble piping using no-hub couplings.
4. Attach 2" x 1½" sanitary tee to assembly end.
5. Join 1½" galvanized pipe using tapped tee for connection.
6. Align and support pipe.
7. Run vent line from soil pipe to revent line, or through roof.

LEARNING ACTIVITIES

1. Discuss the different fixtures that may be connected to a kitchen sink and how this may affect the rough-in height.
2. Explain how fixtures such as dishwashers that drain through the sink waste pipe increase the fixture unit value and possibly increase the drain diameter.
3. Illustrate methods of venting kitchen sink wastes.
4. Demonstrate methods of installing kitchen sink waste and vent piping.
5. Review the maximum height from a fixture waste outlet and its P-trap.

RESOURCES

Ripka. **Plumbing Installation and Design,** pp. 222-226
Matthias and Smith. **How to Design and Install Plumbing,** pp. 358-363
Local plumbing code

EVALUATION

Question
What is the minimum size vent permitted for a kitchen sink?

Answer
The minimum size permitted is 1¼".

Practical Application
Rough in waste lines and vents for kitchen sink.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 53 CHECKLIST

ROUGH IN WASTE LINES AND VENTS FOR KITCHEN SINK

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Given access to tools, equipment, and supplies, rough in waste lines and vents for a kitchen sink according to local codes. Joints must not leak. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide items needed for student to rough in waste lines and vents for a kitchen sink. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Correctly laid out waste line from main line to fixture		
2. Used no-hub coupling		
3. Used correct size and type of tees and pipe		
4. Properly supported and aligned pipe		
5. Correctly vented pipe		
6. Stubbed out waste line within ± 1.2" of specification		
7. Joints do not leak		
8. Installed lines according to local code		

Suggested teaching time
3 periods

DUTY OR UNIT: DRAINAGE AND VENTING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 54

TASK: Install grease interceptors in waste lines.

STANDARD: The description of the installation of a grease interceptor in a waste line must include the information in the performance guide and the Checklist.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Instructional materials and specifications for a grease interceptor with steel inlet and outlet extensions, tools and equipment

PERFORMANCE GUIDE

1. Describe the positioning of interceptor in desired floor location.
2. Describe proper application of sealant to threads of extensions and sink; vent crossover pipes.
3. Describe connection of extensions and crossovers.
4. Describe connections of crossovers to sink drain tailpipe and vent pipe, using union adapters.

LEARNING ACTIVITIES

1. Explain the purpose of a grease interceptor.
2. Illustrate how a grease interceptor works.
3. Discuss locations where grease interceptors should be used.
4. List the different sizes and types of grease interceptors available.
5. Describe how to install a grease interceptor complete with drainage and vent pipes.
6. Illustrate what a flow control valve does and where it is installed.

RESOURCES

Matthias and Smith. **How to Design and Install Plumbing,** pp. 91-94
Slater and Smith. **Advanced Plumbing,** pp. 124-127
Local plumbing code

EVALUATION

Questions

1. Grease interceptors should be placed in an ____________ location for periodic removal of ____________ and routine maintenance.
2. Kitchen sinks in a restaurant must discharge through a __________ ____________ before entering the sanitary sewer.

Answers

1. Accessible, grease
2. Grease interceptor

PERFORMANCE OBJECTIVE V-TECS 54 continued

Practical Application
Install grease interceptor in waste lines.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 54 CHECKLIST

INSTALLATION OF GREASE INTERCEPTORS IN WASTE LINES

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Given access to materials, specifications, and information, describe the installation of a grease interceptor in a waste line. Each step must be identified in sequential order.

DIRECTIONS TO EVALUATOR: Provide the student with items needed to describe the installation of a grease interceptor. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly described the positioning of the interceptor		
2. Described correctly proper application of sealant		
3. Properly described all extension and crossovers		
4. Finished description was complete in all respects		

Suggested teaching time
2 periods

DUTY OR UNIT: DRAINAGE AND VENTING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 55

TASK: Install vent terminals (roof-flashing).

STANDARD: The terminal must be watertight.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Lead hammer, cast-iron main vent pipe, pitched roof situation, tools and equipment

PERFORMANCE GUIDE

1. Select vent terminal to match pitch of roof.
2. Slip vent terminal over vent pipe extending through roof.
3. Depending on type of vent terminal, bend terminal top over vent pipe or beat lead top of terminal into cast-iron vent pipe to seal terminal.
4. Seal flashing with tar compound.

LEARNING ACTIVITIES

1. List the different methods of flashing vent terminals.
2. Explain why vent terminals are increased in size in cold climates.
3. Demonstrate installing a lead flashing and beating it down over a vent terminal.
4. Discuss the good and bad characteristics of the different types of flashings.
5. Emphasize necessary safety precautions when working with ladders and on top of buildings.
6. Explain why vents must not terminate near windows, doors, and air conditioning return air ducts.

RESOURCES

Local plumbing code
Blankenbaker. **Modern Plumbing**, pp. 137-138
Matthias and Smith. **How to Design and Install Plumbing**, pp. 115-118
Oravetz. **Plumbers and Pipefitters Library**, pp. 161-162

EVALUATION

Question
What is installed around a vent or soil stack where it penetrates a roof to make the roof weathertight?

Answer
A roof-flashing is installed.

Practical Application
Install vent terminals (roof-flashing).

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 55 CHECKLIST

INSTALL VENT TERMINALS (ROOF-FLASHING)

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Given access to tools, equipment, and supplies, install a vent terminal. Terminal must be watertight. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide items needed to install a vent terminal. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Correctly selected vent terminal to match roof pitch		
2. Correctly sealed vent terminal according to type used		
3. Sealed flashing with tar compound		
4. Terminal is watertight		

Suggested teaching time
3 periods

DUTY OR UNIT: DRAINAGE AND VENTING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 56

TASK: Make water tests on building drains.

STANDARD: The system should be filled to within 2" of highest stack and no leaks should appear at plugged openings.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Adjustable test plugs, water hose, water supply, tools, and equipment

PERFORMANCE GUIDE

1. Insert test plugs in each opening with the exception of stack above highest fixture.
2. Connect water hose to water supply line and fill stack above highest fixture with water to within 2" of top.
3. Check all plugs and caps for leaks.
4. Allow water to stand in pipe 24 hours.
5. Check pipe for leaks. Observe sand holes in pipe, cracked fittings, and leaks in joints.

LEARNING ACTIVITIES

1. Discuss the reasons for testing D.W.V. systems.
2. List the preparations needed to be done before filling the D.W.V. system with water.
3. Explain the maximum practical heights of hydrostatic pressure tests on D.W.V. systems.
4. Arrange for students to observe a building drain being tested and inspected.
5. Emphasize the possibility of pipes bursting when water testing in freezing weather.
6. Demonstrate installation of test plugs.

RESOURCES

Local plumbing code
Local plumbing inspector
Local plumbing contractor
Slater and Smith. **Basic Plumbing,** pp. 180-182
Blankenbaker. **Modern Plumbing,** pp. 141-142
Ripka. **Plumbing Installation and Design,** pp. 248-249
Matthias and Smith. **How to Design and Install Plumbing,** pp. 209-213

EVALUATION

Questions

1. How many pounds per square inch are exerted at the base of a soil stack filled with ten feet of water?
2. All plumbing must be tested when a building is completed. (True or false)

PERFORMANCE OBJECTIVE V-TECS 56 continued

Answers

1. The amount exerted is 4.34 pounds per square inch.
2. False — Testing must be done before pipes are concealed inside walls.

Practical Application

Make water tests on building drains.

Methods of Evaluating Practical Application

Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE 56 CHECKLIST

MAKE WATER TESTS ON BUILDING DRAINS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Given access to tools, equipment, and materials, make water tests on building drains. No leaks should appear at plugged openings. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide items needed for the student to make water tests on building drains. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly plugged all openings		
2. Filled pipes to within 2" of highest vent		
3. Allowed water to stand in pipes for 24 hours		
4. Checked all pipes and joints for leaks		
5. Removed all plugs after testing was completed		

WATER SYSTEMS

Suggested teaching time
2 periods

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 57

TASK: Determine point of entry of water lines.

STANDARD: Point of entry of water service must be located according to a given set of plans.

SOURCE OF STANDARD: V-TECS writing plans, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A set of blueprints, stakes, string, and appropriate tools

PERFORMANCE GUIDE

1. Select point of entry.
*2. Measure length of pipe required.
*3. Specify pipe diameter.
*4. Drive stakes and pull string along route for pipe.
*5. Identify water meter location.

LEARNING ACTIVITIES

1. Demonstrate how to check the blueprint site plan for location of obstructions such as:
   a. Gas mains
   b. Power lines
   c. Sewer lines
   d. Trees
   e. Other obstructions
2. Show how to check the elevation contours.
3. Explain how to "sleeve" a water line entering a building.
4. Arrange for class to watch water line installation by a local contractor.
5. Discuss ways to protect people from falling or driving into open ditches.
6. Establish water meter location.
7. Select water line size to building.

RESOURCES

Blankenbaker. **Modern Plumbing,** Unit 7
Local plumbing code
Local contractor

EVALUATION

Question

Name at least three things to avoid when planning a route for a water line.

Answer

You must avoid gas mains, power lines, sewer lines, trees, and other water lines.

*Steps were determined to be necessary by the South Carolina Curriculum Writing Team.

PERFORMANCE OBJECTIVE V-TECS 57 continued

Practical Application
The instructor will provide you with a blueprint site plan. Determine the point of entry of water lines. Identify all the obstructions.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 57 CHECKLIST

DETERMINE POINT OF ENTRY OF WATER LINES

STUDENT'S NAME

EVALUATOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: The instructor will provide you with a blueprint site plan. Determine the point of entry of water lines. Identify all the obstructions.

DIRECTIONS TO EVALUATOR: Provide the student with the blueprint site plan. Observe the student's reasoning for identifying the obstructions. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Located water meter (if applicable)		
2. Properly located point of entry to building		
3. Correctly measured distance for pipe length		
4. Properly sized pipe according to specifications		
5. Properly staked pipe for straightness of line		
6. Avoided obstructions		

Suggested teaching time
4 periods

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 58

TASK: Size water supply system.

STANDARD: Pipe size must agree with those determined by the instructor.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Plumbing specifications, tools and equipment

PERFORMANCE GUIDE

1. Determine minimum size pipe for each fixture.
2. Calculate maximum load of water required at any given time.

LEARNING ACTIVITIES

1. Identify the types of pipe that will meet local plumbing codes.
2. Distribute a list of minimum sizes of water supply pipe sizes for each fixture.
3. Explain how head pressure and friction loss have a pressure reducing effect on incoming water supply.
4. Discuss velocity.
5. Describe water supply fixture units (W.S.F.U.).
6. Compare different rates of water consumption according to types of occupancy.
7. Identify the minimum and maximum pressures allowed in a water pipe system.
8. Explain sizing pipe by these methods.
    a. Velocity method
    b. Pressure loss method

RESOURCES

Local plumbing code
Slater and Smith. **Advanced Plumbing,** Units 19 and 20
Mathias and Smith. **How to Design and Install Plumbing,** pp. 235-245, 263-271
Ripka. **Plumbing Installation and Design,** Chapter 9
National Plumbing Code

EVALUATION

Questions

1. How much pressure is expected at the base of a column of water 1" x 1" x 12" high?
2. What is friction loss in a water supply system?
3. What size water supply pipes should the following fixtures have?
    a. Kitchen sink (domestic)
    b. Water closet (tank type)
    c. Water closet (flushometer valve)
4. What minimum size supply pipe should be run to a two bathroom dwelling?

PERFORMANCE OBJECTIVE V-TECS 58 continued

Answers

1. Pressure needed is .434 lb.
2. Friction loss is loss of water pressure due to the resistance of water rubbing against the interior walls of pipes.
3. a. 1/2"
   b. 3/8"
   c. 1"
4. 3/4"

Practical Application
Using job specifications, determine the correct size pipes and calculate the maximum required load of water.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 58 CHECKLIST

SIZE WATER SUPPLY SYSTEM

STUDENT'S NAME ____________________   EVALUATOR'S NAME ____________________

DATE ____________________   DATE ____________________

DIRECTIONS TO STUDENT: Using job specifications, determine the correct size pipes and calculate the maximum required load of water.

DIRECTIONS TO EVALUATOR: Provide student with job specifications in order to determine water supply system. Observe the student's calculations. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Determined minimum size pipe for each fixture		
2. Calculated maximum required load of water		
3. Pipe size agreed with specifications		
4. Used proper type of pipe		

Suggested teaching time
2 periods

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 59

TASK: Install cut-off valve in stop and waste box.

STANDARD: Connections must not leak.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: 1" diameter water supply line leading from a main line to a building and access to plumbing tools

PERFORMANCE GUIDE

1. Clean pipe ends before joining.
2. Connect gate valve to supply pipe using proper fittings.
3. Dig hole around valve for prefabricated stop and waste box.
4. Install prefabricated concrete or cast-iron stop and waste box over valve.
5. Place gravel in bottom of box.
6. Place lid on box.

LEARNING ACTIVITIES

1. Explain the importance of not driving a pick or shovel too deep and hard when looking for water line.
2. Discuss what might happen if the water was not shut off before cutting pipe.
3. Adjust tightness of valve packing nut and explain why.
4. Describe what may happen to shape of valve if wrench is used on its end without nipple inserted.
5. Explain why the student must not overtighten the valve and stretch the metal.
6. Illustrate and discuss what could happen if a stop and waste valve was installed below ground level and a water main breakage occurred.
7. Identify the frost line using the Student Information Sheet.
8. Emphasize the importance of not installing metal pipe in acid soils.

RESOURCES

Local plumbing code
Blankenbaker. **Modern Plumbing,** pp. 60-63
Slater and Smith. **Advanced Plumbing,** pp. 63-66
Student Information Sheet

EVALUATION

Questions

1. How deep is the frost line?
2. Why is it important to tamp dirt back around the stop and waste box?
3. Why should care be taken not to overtighten a valve?
4. Which type of pipe should be used in acid soil conditions?
   a. Galvanized iron
   b. Copper
   c. Plastic
   d. Black steel

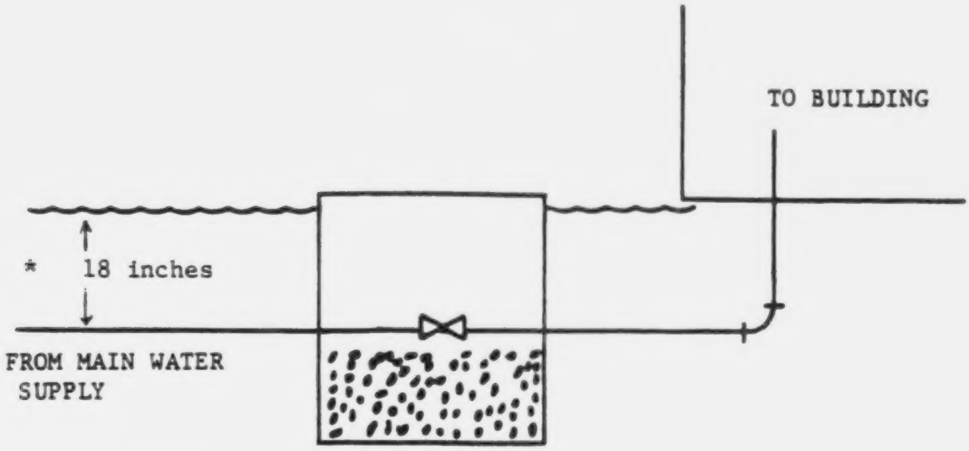
Answers

1. Locality will determine frost line. South Carolina requires 18 inches.
2. a. The dirt may settle later exposing pipe to freezing conditions.
   b. This could be a possible hazard to pedestrians.
   c. This situation could be unsightly.
3. Metal may be stretched which could cause a leak.
4. c

Practical Application
Install a cut-off valve in stop and waste box. Connections must not leak.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 59
STUDENT INFORMATION SHEET


TO BUILDING
* 18 inches
FROM MAIN WATER SUPPLY

Typical Cut-Off

*Minimum for freeze protection in South Carolina

PERFORMANCE OBJECTIVE V-TECS 59 CHECKLIST

INSTALL CUT-OFF VALVE IN STOP AND WASTE BOX

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Install a cut-off valve in stop and waste box. Connections must not leak. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to install the cut-off valve. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Cleaned pipe ends before joining		
2. Connected gate valve to supply line with proper fittings		
3. Used correct stop and waste box		
4. Placed gravel in bottom of box		
5. Placed lid on box		
6. Connections did not leak		
7. Placed pipe and fittings below frost line		
8. Replaced dirt and tamped around box to finished grade level		

Suggested teaching time
2 periods

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 60

TASK: Install check valves on water feed lines.

STANDARD: The valve must be leakproof.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A check valve, a water supply requiring the valve, and appropriate tools

PERFORMANCE GUIDE

1. Determine direction of water flow in supply line.
2. Identify proper direction of water flow in valve.
3. Measure, cut, and thread pipe for inlet and outlet supply.
4. Assemble components.
5. Connect union in supply line.
6. Connect valve. If it is a swing-type check valve, install with swing pendulum in downward position.

LEARNING ACTIVITIES

1. Arrange for class to visit a mechanical equipment room and observe a check valve installation.
2. Explain the importance of installing check valves in their correct positions.
3. Identify the different types of check valves and explain their uses.
4. Describe what could happen if a check valve was installed in a water feed-line to a boiler and the temperature and pressure-relief valve was plugged.
5. Show the class why check valves are installed in water feed lines.

RESOURCES

Slater and Smith. **Advanced Plumbing,** Section 3, Unit 14
Blankenbaker. **Modern Plumbing,** pp. 64-65
Slater. **Related Information, Plumbing 2,** pp. 58-59
Local plumbing code

EVALUATION

Questions

1. What is the purpose of a check valve?
2. What happens when a check valve is not installed at the right angle?
   a. Pressure increases.
   b. Pressure decreases.
   c. Will not operate.
   d. Turbulence is created.

Answers

1. It prevents fluids from flowing in the wrong direction.
2. c

PERFORMANCE OBJECTIVE V-TECS 60 continued

Practical Application
Install check valves on water feed lines. Pipe must be correctly cut, threaded, and joined. Valve and joints cannot leak.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 60 CHECKLIST

INSTALL CHECK VALVES ON WATER FEED LINES

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Install check valves on water feed lines. Pipe must be correctly cut, threaded, and joined. Valve and joints cannot leak.

DIRECTIONS TO EVALUATOR: Give access to tools, equipment, and materials for the student to install check valves on water feed lines. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Correctly determined water flow direction in supply line.		
2. Correctly determined water flow direction in valve.		
3. Correctly cut and threaded pipe.		
4. Used union in supply line.		
5. Correctly joined pipe.		
6. If swing valve was used, is pendulum positioned downward?		
7. Valve and joints do not leak.		

Suggested teaching time
2 periods

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 61

TASK: Rough in water supply lines for bathtubs.

STANDARD: 1/2" diameter copper water supply lines must be roughed in for a shower bath and tub according to specifications.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A water supply line above or below a bathroom floor level, manufacturer's specifications, and access to plumbing tools, equipment and supplies. The location of stubbed-out lines must be within ± 1/2" of the manufacturer's specifications.

PERFORMANCE GUIDE

1. Solder tee on main hot and cold water lines.
2. Connect hot and cold water lines for tub and shower bath to main line tees.
3. Anchor over-rim filler valve in bath wall at proper height and depth.
4. Connect hot and cold water lines to shower-filler valve with cold water on right facing fixture.
5. Anchor and support tubing as necessary.
6. Solder and anchor shower arm riser.
7. Install shower diverter arm.
8. Cap shower riser and diverter arm lines.

LEARNING ACTIVITIES

1. Establish the correct location of the tub and shower valve.
2. Show how to assemble and install the valve and tub fill spout.
3. Demonstrate installation of the shower riser.
4. Explain how to anchor the complete assembly to its backing.
5. Discuss possible cross connections from an incorrect location of the tub fill spout.

RESOURCES

Blankenbaker. **Modern Plumbing**, pp. 172-175
Ripka. **Plumbing Installation and Design**, pp. 218-222
Local plumbing code
Slater and Smith. **Basic Plumbing**, pp. 118-122

EVALUATION

Questions

1. Why should outside walls be avoided when installing water pipes?
2. The hot and cold side of a tub/shower valve must be set back an equal distance from finished wall. Explain why.
3. What should be done to prevent sheet rock nails from puncturing riser pipes?
4. Why must pipes be flushed out before screwing on the shower head outlet?
5. Why must there be an air gap between tub fill spout and the flood level rim?

PERFORMANCE OBJECTIVE V-TECS 61 continued

Answers

1. Avoid outside walls to protect the pipes from freezing.
2. This distance is necessary so that the trim will fit against the finished wall and have a neat appearance.
3. a. Install pipes in center of wall.
   b. Install protector plates in front of pipes.
4. Flush pipes to remove flux and solder and other particles from the pipes. This will avoid stopping up the outlet holes.
5. There must be an air gap to protect against a possible cross connection by back siphonage.

Practical Application

Rough in supply lines for bath tub according to specifications.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 61 CHECKLIST

ROUGH IN WATER SUPPLY LINES FOR BATHTUBS

STUDENT'S NAME

EVALUATOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: Rough in supply lines for bathtub according to specifications. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to rough in water supply lines for a bathtub. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Soldered tee on main hot and cold supply lines		
2. Correctly connected lines for tub and shower to main line tees		
3. Properly installed over rim filler valve in bath wall		
4. Positioned cold water valve on right		
5. Anchored and supported tubing as needed		
6. Installed shower diverted arm		
7. Capped all lines		
8. Located lines within ± ½" of specifications		

Suggested teaching time
2 periods

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 62

TASK: Rough in water supply lines for wall-mounted urinals.

STANDARD: A 3/4" or 1" diameter copper water supply line for a wall-mounted urinal must be roughed in according to specifications.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A previously installed cold water line above or below the floor level, fixture manufacturer's rough-in specifications, and access to plumbing tools, equipment, and supplies

PERFORMANCE GUIDE

1. Mark location of water supply line on wall as per specifications.
2. Solder copper tee on main water supply line, if necessary.
3. Connect water supply branch to main supply tee.
4. Run tubing out of wall at correct height from floor.
5. Anchor and support supply line as necessary.
6. Cap end of fixture supply line.
7. Install air chamber, if required.

LEARNING ACTIVITIES

1. Arrange for class to observe a correctly installed and functioning urinal flushometer valve.
2. Describe some different types of flushometer valves.
3. Explain how to use the manufacturer's rough-in specifications.
4. Show how to install the backing and support for the water supply riser.
5. Discuss the effects of a loose pipe in a wall where the flushometer valve is attached.
6. Demonstrate how to install an air chamber.

RESOURCES

Blankenbaker. **Modern Plumbing**, pp. 63-64
Kipka. **Plumbing Installation and Design**, pp. 213-214
Local plumbing code

EVALUATION

Practical Application
Rough in water supply lines for wall-mounted urinals according to specifications.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 62 CHECKLIST

ROUGH IN WATER SUPPLY LINES FOR WALL-MOUNTED URINALS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Rough in water supply lines for wall-mounted urinals according to specifications. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to rough in water supply lines for wall-mounted urinals. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Installed water supply tubing according to rough-in dimensions + ½"		
2. Joints are leakproof		
3. Tubing is not in contact with corrosive materials		
4. Properly anchored tubing		
5. Finished assembly is neat in appearance		
6. Finished task within established time limit		

Suggested teaching time
1 period

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 63

TASK: Rough in water supply lines for water closets.

STANDARD: A 1/2", 3/4", or 1" diameter copper water supply line must be roughed in for a water closet. Joints must not leak.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A previously installed cold water line above or below the floor level, fixture manufacturer's rough-in specifications, and access to plumbing tools, equipment, and supplies. The stubbed-out supply lines must be located within ± 1/2" of the manufacturer's specifications.

PERFORMANCE GUIDE

1. Mark location of water supply line on wall. Normally, supply line is roughed in 6" off center of fixture.
2. Solder tee on main water supply line, if necessary.
3. Connect fixture supply branch to main supply tee.
4. Install air chamber on fixture supply line, if required.
5. Install supply line out of wall at correct height from floor. Normally, tubing should protrude 6" out of wall.
6. Anchor and support supply line as necessary.
7. Cap end of fixture supply line.

LEARNING ACTIVITIES

1. Show the point of entry for the water supply on a tank-type water closet.
2. Explain what should be done to protect water pipes when installed in an exterior wall.
3. Show how to check for and avoid drilling into a floor joist from above the floor.
4. Demonstrate how to establish the finished floor level before measuring water supply rough-in height.
5. Demonstrate methods of anchoring pipe.

RESOURCES

Matthias and Smith. **How to Design and Install Plumbing**, pp. 337-340
Blankenbaker. **Modern Plumbing**, pp. 123-125
Local plumbing code

EVALUATION

Questions

1. Why is it better to bring the water supply piping to a water closet up through the wall instead of the floor?
2. What should be done to pipes when installing in an exterior wall?
3. It is not necessary to provide a shut off valve under a water closet tank as the ballcock shuts off the incoming water. (True or false)

Answers

1. a. The floor is more easily installed.
   b. Bathroom floor is more easily cleaned.
2. They should be insulated for protection.
3. False

Practical Application

Rough in water supply lines for water closet according to specifications.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 63 CHECKLIST

ROUGH IN WATER SUPPLY LINES FOR WATER CLOSETS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Rough in water supply lines for water closet according to specifications. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to rough in water supply lines for water closet. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Stubbed water supply line out 6" above finished floor level		
2. Supply line offset centerline the correct distance		
3. Anchored and supported pipe as needed		
4. Capped supply line		
5. Joints do not leak		
6. Supply line located within ± ½" of specifications		

Suggested teaching time
2 periods

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 64

TASK: Rough in water supply lines for showers.

STANDARD: 1/2" diameter copper water supply lines must be roughed in for a shower according to specifications.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A water supply line above or below a bathroom floor level, manufacturer's specifications and access to plumbing tools, equipment and supplies. The location of stubbed-out lines must be within ± ½" of the manufacturer's specifications.

PERFORMANCE GUIDE

1. Solder tee on main hot and cold water lines.
2. Connect hot and cold water lines for shower to main line tees.
3. Connect hot and cold water lines to shower valve with cold water on right facing fixture.
4. Anchor and support tubing as necessary.
5. Solder and anchor shower arm riser.
6. Install shower diverter arm.
7. Cap end of fixture supply lines.

LEARNING ACTIVITIES

1. Identify the different types of shower valves.
2. Explain the importance of installing hot water supply on left side.
3. Emphasize the importance of following manufacturer's rough-in dimensions so that the trim and handles will fit upon job completion.
4. Describe what may happen if hot and cold lines are allowed to touch each other after installation.
5. Demonstrate how to lay out, measure and drill holes in a fiberglass shower stall.
6. Discuss practical useable heights for installing the valve handles and shower heads.
7. Emphasize the need to keep the valve cool when soldering in close proximity.

RESOURCES

Blankenbaker. **Modern Plumbing**, pp. 172-175
Ripka. **Plumbing Installation and Design**, pp. 218-221
Local plumbing code

EVALUATION

Questions

1. What is the purpose of an air chamber?
2. At what height should a shower mixing valve be installed?
   a. 2'6"
   b. 4'
   c. 5'6"
   d. 6'

Answers

1. The purpose of an air chamber is to prevent water hammer.
2. b

Practical Application

Rough in water supply lines for shower according to specifications.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 64 CHECKLIST

ROUGH IN WATER SUPPLY LINES FOR SHOWERS

STUDENT'S NAME ______________ EVALUATOR'S NAME ______________

DATE ______________ DATE ______________

DIRECTIONS TO STUDENT: Rough in water supply lines for shower according to specifications. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to rough in water supply lines for shower. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Correctly soldered tee on supply lines		
2. Properly connected fixture lines to main line tees		
3. Anchored and supported tubing as needed		
4. Anchored shower arm riser		
5. Installed shower diverter arm		
6. Capped all supply lines		
7. Installed all stubbed out lines within ± ½" of specifications		

Suggested teaching time
2 periods

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 65

TASK: Rough in water supply lines for kitchen sink.

STANDARD: 1/2" diameter copper water supply lines must be roughed in for a kitchen sink according to specifications.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A water supply line above or below a kitchen floor level, manufacturer's specifications, and access to plumbing tools, equipment, and supplies. The location of stubbed-out lines must be within + 1/2" of the manufacturer's specifications.

PERFORMANCE GUIDE

1. Solder tee on main hot and cold water lines.
2. Connect hot and cold water lines for kitchen sink to main line tees.
3. Anchor over-rim filler valve in kitchen wall at proper height and depth.
4. Connect hot and cold water lines to kitchen sink valve with cold water on right facing fixture.
5. Anchor and support tubing as necessary.
6. Cap end of supply lines.

LEARNING ACTIVITIES

1. Explain how to install insulated pipes in an exterior wall.
2. Describe the problems that may arise if water supply lines are stubbed out too close to the sink waste arm.
3. Demonstrate methods of piping supports.
4. Show how to protect piping subject to nail penetrations.
5. Show how to install air chambers.

RESOURCES

Ripka. **Plumbing Installation and Design**, pp. 222-224

EVALUATION

Question

How far apart should the hot and cold water lines to a kitchen sink be stubbed out of the wall?

a. 4"
b. 6"
c. 8"
d. 12"

Answer

c

PERFORMANCE OBJECTIVE V-TECS 65 continued

Practical Application
Rough-in water supply lines for kitchen sink according to specifications.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuacy.

PERFORMANCE OBJECTIVE V-TECS 65 CHECKLIST

ROUGH IN WATER SUPPLY LINES FOR KITCHEN SINK

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Rough in water supply lines for kitchen sink according to specifications. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to rough in water supply lines for a kitchen sink. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Soldered tee on supply lines correctly		
2. Correctly connected kitchen sink lines to tees on main lines		
3. Properly anchored over-rim filler valve in kitchen wall		
4. Connected hot and cold lines to sink with cold on right		
5. Anchored and supported tubing as needed		
6. Capped supply line ends		
7. Stubbed out lines within ± ½" of specifications		

Suggested teaching time
2 periods

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 66

TASK: Rough in water supply lines for lavatories.

STANDARD: 1/2" diameter copper water supply lines must be roughed in for a lavatory according to specifications.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A water supply line above or below a bathroom floor level, manufacturer's specifications, and access to plumbing tools, equipment, and supplies. The location stubbed-out liens must be within ± 1/2" of the manufacturer's specifications.

PERFORMANCE GUIDE

1. Solder tee on main hot and cold water lines.
2. Connect hot and cold water lines for lavatory to main line tees.
3. Anchor over-rim filler valve in bath wall at proper height and depth.
4. Connect hot and cold water lines to valve, with cold water on right facing fixture.
5. Anchor and support tubing as necessary.
6. Cap end of supply lines.

LEARNING ACTIVITIES

1. Distribute rough-in sheets as supplied by manufacturer.
2. Demonstrate how to take dimensions from rough-in sheets.
3. Explain how to anchor water pipes in the wall.
4. Describe what will happen if nails are used instead of pipe straps.
5. Explain why fixture supply stops are not installed until the walls are finished.

RESOURCES

Blankenbaker. **Modern Plumbing**, pp. 167-171
Local plumbing code

EVALUATION

Questions

1. Why should the water supply line ends be capped?
2. An air chamber greatly reduces water hammer under which conditions?
    a. The air in the chamber compresses the water.
    b. The air chamber expands letting the water expell inert gases.
    c. The air in the chamber is compressed by the water until equal to the shock wave.
    d. The air chamber overides the water pressure.

Answers

1. Water supply lines should be capped for testing by pressure.
2. c

PERFORMANCE OBJECTIVE V-TECS 66 continued

Practical Application
Rough in water supply lines for lavatories according to specifications.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 66 CHECKLIST

ROUGH IN WATER SUPPLY LINES FOR LAVATORIES

STUDENT'S NAME EVALUATOR'S NAME

DATE DATE

DIRECTIONS TO STUDENT: Rough in water supply lines for lavatories according to specifications. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to rough in water supply lines for lavatories. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Soldered tees correctly on main supply lines.		
2. Connected water lines for lavatory to main line tees.		
3. Anchored over-rim filler valve to wall.		
4. Fastened supply lines to valves with cold on right.		
5. Capped supply line ends.		
6. Installed all lines within ± ½" of specifications.		

Suggested teaching time
2 periods

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 67

TASK: Rough in water supply lines for washer.

STANDARD: 1/2" diameter copper water supply lines for a washer must be roughed-in according to manufacturer's specifications.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Water supply line above or below floor level, manufacturer's specifications, and access to plumbing tools, equipment, and supplies. The location of stubbed-out lines must be within ± 1/2" of the manufacturer's specifications.

PERFORMANCE GUIDE

1. Solder tee on main hot and cold water lines.
2. Connect hot and cold water lines for washer to main tee lines.
3. Anchor over-rim filler valve in wall at proper height and depth.
4. Connect hot and cold water lines and washer valve with cold water on right.
5. Anchor and support tubing as necessary.
6. Cap ends of supply lines.

LEARNING ACTIVITIES

1. Emphasize the importance of securely strapping supply pipes in the wall.
2. Demonstrate how to install a manufactured washing machine water and drain box.
3. Explain how to install the hot and cold water supply stops without burning the water and drain box.
4. Discuss the height limitations so that the valves can be reached but not seen.
5. Show the class how to install the water pipes so that insulation can be installed if needed.
6. Explain why the hot and cold water lines must be flushed out before connecting the washing machine hoses.

RESOURCES

Ripka. **Plumbing Installation and Design,** pp. 226-227
Manufacturer's specifications

EVALUATION

Questions

1. Why must the hot and cold water supply lines be flushed out before installing washing machines hoses?
2. What is the minimum size water supply line to a washing machine?
   a. 3/8"
   b. 1/2"
   c. 3/4"
   d. 1"

PERFORMANCE OBJECTIVE V-TECS 67 continued

Answers

1. Lines must be flushed out to prevent trash from blocking the mesh screens and solenoid valve in the washing machine.
2. b

Practical Application

Rough in water supply lines for washer according to specifications.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 66 CHECKLIST

ROUGH IN WATER SUPPLY LINES FOR LAVATORIES

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Rough in water supply lines for lavatories according to specifications. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to rough in water supply lines for lavatories. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Soldered tees correctly on main supply lines		
2. Connected water lines for lavatory to main line tees		
3. Anchored over-rim filler valve to wall		
4. Fastened supply lines to valves with cold on right		
5. Capped supply line ends		
6. Installed all lines within ± ½" of specifications		

Suggested teaching time
2 periods

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 68

TASK: Rough in water supply lines for water heaters.

STANDARD: A 3/4" diameter copper water supply line for a hot water heater must be roughed in according to manufacturer's specifications. Joints must not leak.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A previously installed cold water line above or below the floor level, fixture manufacturer's rough-in specifications, and access to plumbing tools, equipment, and supplies. The stubbed-out supply line must be located within ± 1/2" of the manufacturer's specifications.

PERFORMANCE GUIDE

1. Mark location of water supply line on wall.
2. Solder tee on main supply line, if necessary.
3. Connect fixture supply branch to main supply tee.
4. Install supply line out of wall at correct height. Normally, tubing must protrude 6" out of wall.
5. Anchor and support supply line as necessary.
6. Cap end of fixture supply line.

LEARNING ACTIVITIES

1. Identify the different types of water heaters.
2. Distribute information sheets on how to connect water lines to a bottom feed water heater.
3. Explain why dielectric connections are used when connecting copper water lines to a steel-tank water heater.
4. Emphasize why temperature and pressure relief valves cannot be trapped.
5. Show how to anchor water supply lines in the wall.
6. Illustrate the position of the shut-off valve in the cold water line to the water heater.

RESOURCES

Local plumbing code
Ripka. **Plumbing Installation and Design,** pp. 279, 235-240
Manufacturer's specifications
Blankenbaker. **Modern Plumbing,** pp. 74-80
Student Information Sheet

EVALUATION

Practical Application
Rough in water supply lines for water heater according to specifications.

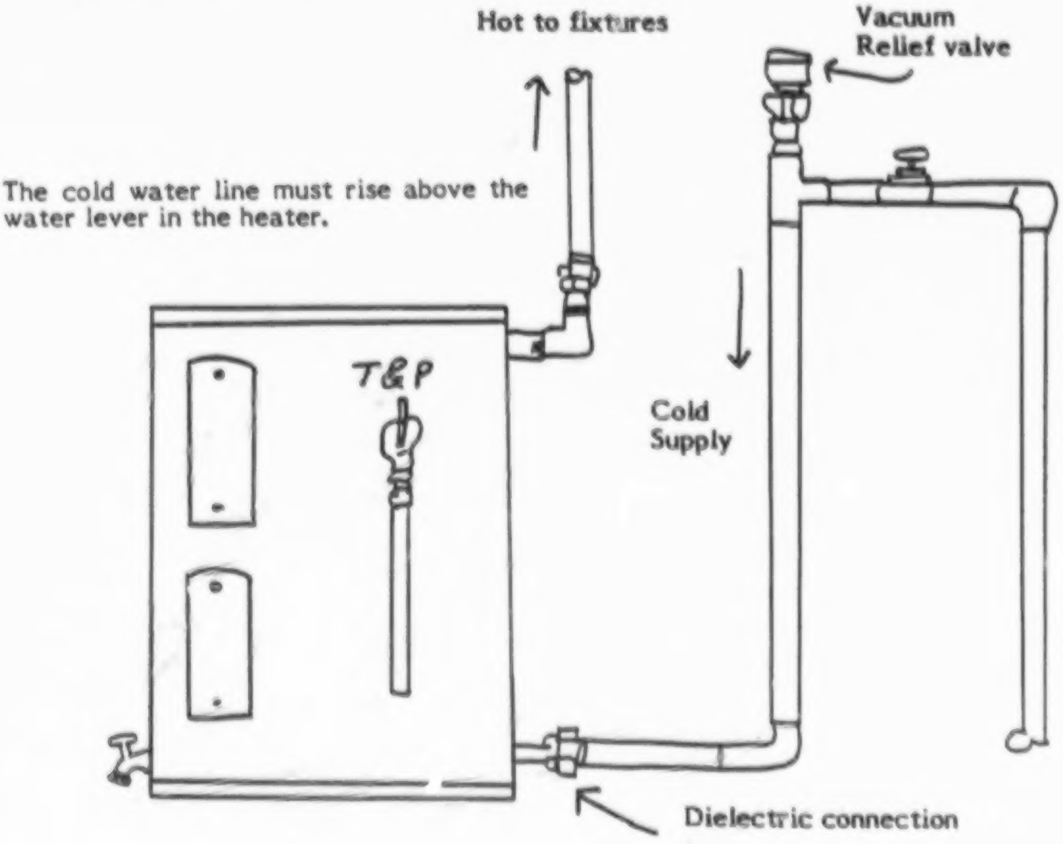
Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 68

STUDENT INFORMATION SHEET

Bottom Feed

Water Heater


Hot to fixtures
Vacuum
Relief valve
T&P
Cold
Supply
Dielectric connection

The cold water line must rise above the water lever in the heater.

This is a method of preventing back siphonage should a negative pressure occur in cold water supply.

PERFORMANCE OBJECTIVE V-TECS 68 CHECKLIST

ROUGH IN WATER SUPPLY LINES FOR WATER HEATERS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Rough in water supply lines for water heater according to specifications. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to rough in water supply lines for water heater. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Correctly marked location of water supply line		
2. Soldered tee on main supply line		
3. Properly connected fixture supply branch to main supply tee		
4. Installed supply line out of wall at correct height, protruding about 6"		
5. Anchored and supported supply line as needed		
6. Capped supply line end		
7. Joints do not leak		
8. Installed line within ± ½" of specifications		

Suggested teaching time
3 periods

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 69

TASK: Make water pressure tests on water suppply systems.

STANDARD: The water supply lines in a building must be tested for leaks. Test make-ups should resemble the diagram on the Student Information Sheet.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Necessary tools, equipment, materials and a hydrostatic pump

PERFORMANCE GUIDE

1. Cap or plug all open water supply points in building.
2. Assemble testing apparatus similar to Student Information Sheet.
3. Connect testing apparatus at temporary water service valve.
4. Remove cap or plug from uppermost supply point — bleed air and recap.
5. Purge air from system using bleed method.
6. Apply desired pressure to system using pump.
7. Close gate valve nearest pump — observe gauge for pressure drop. (If drop occurs, check system for leaks.)
8. If no drop in pressure has occurred, note pressure reading and close second gate valve.
9. Recheck in one hour by opening second gate valve and observing pressure drop.
10. Close both gate valves. Remove pump, allow system to remain pressurized 24 hours, and recheck.

LEARNING ACTIVITIES

1. Demonstrate the hook-up and operation procedure of the testing apparatus.
2. Discuss possible effects of leaks in concealed places within a building structure.
3. Identify several methods of finding leaks.
4. Demonstrate how the sun may increase pressure in a closed system by thermal expansion.
5. Visit a job site during testing of the potable water system.
6. Identify the minimum pressure required for a successful test.

RESOURCES

Ripka. **Plumbing Installation and Design,** pp. 243-244, 250-252, 254-255
Local plumbing code
Local contractor
Student Information Sheet

EVALUATION

Questions

1. Name at least two important reasons for applying a hydrostatic pressure test on a water supply system.
2. How might calculated air chambers affect a hydrostatic pressure test?
3. How much pressure should be applied when testing a potable water piping system?

PERFORMANCE OBJECTIVE V-TECS 69 continued

Answers

1. a. To check for leaks
   b. Customer protection
   c. Certify plumbing installation
2. They may trap air and give a false pressure reading.
3. Apply at least as much pressure as the nominal working pressure of the completed system.

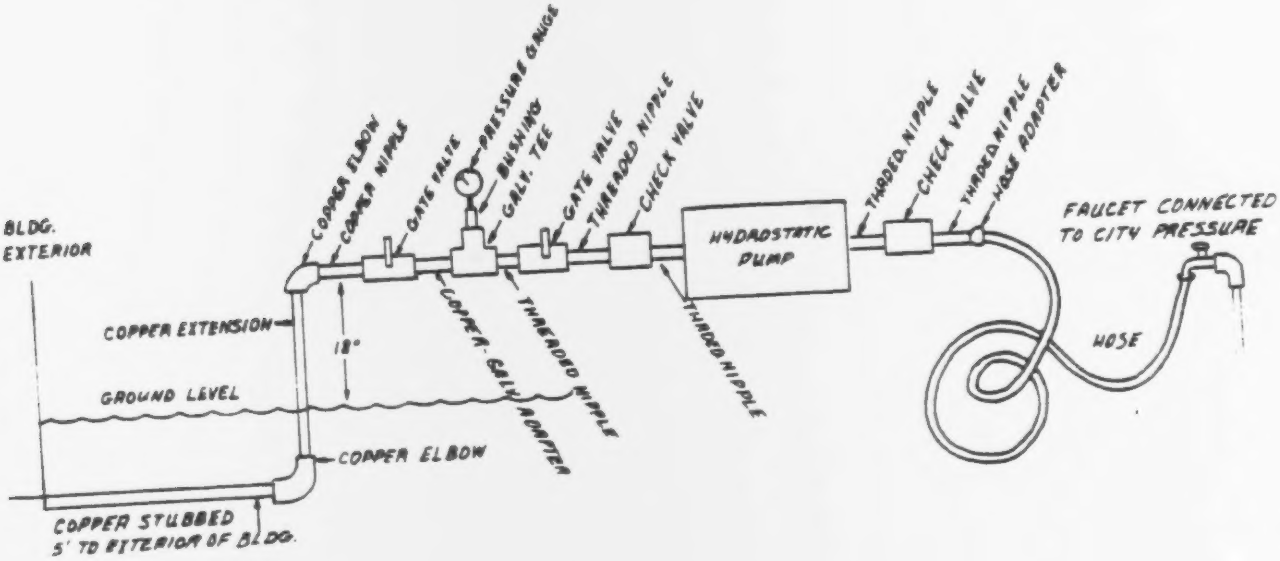
Practical Application

Make water pressure test on supply system using the proper equipment.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 69
STUDENT INFORMATION SHEET


BLDG. EXTERIOR
COPPER ELBOW
COPPER NIPPLE
GATE VALVE
PRESSURE GAUGE
BUSHING
GALV. TEE
GATE VALVE
THREADED NIPPLE
CHECK VALVE
HYDROSTATIC PUMP
THRDED NIPPLE
CHECK VALVE
THRDED NIPPLE
HOSE ADAPTER
FAUCET CONNECTED TO CITY PRESSURE
HOSE
COPPER EXTENSION
18"
COPPER-GALV. ADAPTER
THREADED NIPPLE
THRDED NIPPLE
GROUND LEVEL
COPPER ELBOW
COPPER STUBBED 5' TO EXTERIOR OF BLDG.

PERFORMANCE OBJECTIVE V-TECS 69 CHECKLIST

MAKE WATER PRESSURE TESTS ON WATER SUPPLY SYSTEMS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Make water pressure test on supply system using the proper equipment.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to make water pressure tests on water supply system. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Installed test equipment correctly		
2. Capped or plugged all supplies		
3. Made system checks at correct intervals		
4. Bled system correctly		
5. Used correct test pressure		

Suggested teaching time
3 periods

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 70

TASK: Insulate water lines.

STANDARD: The description of the procedure for properly insulating a hot water line must be acceptable to the instructor.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: Insulation material, tools and equipment, hot water line

PERFORMANCE GUIDE

Describe the proper insulation of a hot water line from the hot water heater to a fixture.

LEARNING ACTIVITIES

1. Describe different types of insulation.
2. Explain why insulation must be kept dry to be effective.
3. Demonstrate how to miter and fit insulation around pipe fittings and valves.
4. Demonstrate assembly and gluing procedure of a porous, rubber pipe insulation.
5. Arrange for class to visit a job site and observe pipe insulation being applied.
6. List different situations where insulation must be applied (hot and cold pipes).

RESOURCES

Ripka. **Plumbing Installation and Design,** p. 235
Matthias and Smith. **How To Design and Install Plumbing,** pp. 254-255
Slater and Smith. **Advanced Plumbing,** pp. 144-148
Starbuck. **Steam and Hot Water Heating,** pp. 88-90
Local insulation contractor

EVALUATION

Questions

1. Why is a water heater insulated?
   a. To prevent electrical shock
   b. To retard heat loss
   c. To prevent unnecessary heat in the kitchen
   d. To prevent condensation
2. Why is a chilled water line in a ceiling insulated?
   a. To stop it from freezing
   b. To slow down the corrosion process
   c. To prevent condensation
   d. To prevent against frostbite when touched

PERFORMANCE OBJECTIVE V-TECS 70 continued

Answers
1. b
2. c

Practical Application
Insulate water line with proper material.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 70 CHECKLIST

INSULATE WATER LINES

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Insulate water line with proper material. Clean work area and store tools properly.

DIRECTIONS TO EVALUTOR: Provide access to tools, equipment, and materials needed for the student to insulate water line. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Cut insulation to correct lengths		
2. Cut angles to a good air tight fit		
3. Applied correct amount of glue		
4. Performed work in a well-ventilated area		
5. Completed work has neat appearance		
6. Cleaned up job site		

Suggested teaching time
2 periods

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 71

TASK: Install water circulating pumps.

STANDARD: A water circulating pump must be installed in the system according to specifications.

SOURCE OF STANDARD: None given in the catalog.

CONDITIONS FOR PERFORMANCE OF TASK: A hot water heating system and plumbing tools and supplies

PERFORMANCE GUIDE

1. Determine space required for pump.
2. Connect water supply pipe leading to pump; cut threads on pipe end leading to pump and install half union.
3. Join nipple to pump inlet; install half union on nipple.
4. Connect nipple to pump outlet.
5. Join half union to nipple.
6. Thread end of pipe leading from pump and install half union.
7. Place pump in position.
8. Connect pump to inlet and outlet lines.
9. Call electrician to connect electrical wiring to pump.
10. Test pump for proper operation.

LEARNING ACTIVITIES

1. Explain the reasons for installing a circulating hot water system.
2. Position a pump loosely against a steel beam and demonstrate the noise effects of an improperly installed water pump.
3. Compare the advantages of the centrifugal type of pump over others for circulating water.
4. Explain the need for lubrication of the pump bearings.
5. Compare flow rates of different sized pumps.
6. Discuss flow rates needed in the system in relation to size of pump.
7. Explain how to anchor the pump to a nearby wall or floor.

RESOURCES

Matthias and Smith. **How to Design and Install Plumbing**, pp. 260-261
Blankenbaker. **Modern Plumbing**, pp. 184-186, 199-204
Local plumbing code
Oravetz. **Plumbers and Pipefitters Library**, pp. 59-60, 96-103

EVALUATION

Questions

1. What is the purpose of a circulating hot water system?
2. Why should a gate valve be installed on each side of the pump?
3. What type of propulsion method does the centrifugal pump use?
    a. Single-action
    b. Double-action
    c. Duplex poston
    d. Impeller
4. A typical circulating pump is very efficient. (True or false)
5. Why are the working parts of a circulating pump built of brass or bronze?

Answers

1. A circulating hot water system provides a constant source of hot water throughout a building.
2. This procedure will isolate the pump for maintenance.
3. d
4. False
5. Brass or bronze will resist corrosion.

Practical Application

Install water circulating pump according to specifications.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 71 CHECKLIST

INSTALL WATER CIRCULATING PUMPS

STUDENT'S NAME ____________ EVALUATOR'S NAME ____________

DATE ____________ DATE ____________

DIRECTIONS TO STUDENT: Install water circulating pump according to specifications. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, materials, and equipment needed for the student to install a water circulating pump. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Placed pump in position specified by manufacturer		
2. Pump operates properly when activated		
3. Pipe joints did not leak when pump was activated		
4. Finished work was neat in appearance		
5. Work area was left clean by trainee		
6. Work was performed within established time limit		

Suggested teaching time
3 periods

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 72

TASK: Install lawn sprinkler system.

STANDARD: The installation of a 2" diameter PVC pipe and underground sprinkler heads for lawn water service must be described for an outside area 50' x 20'. Completed work must provide uniform coverage of the lawn area with water when the sprinkling system is activiated.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: A water supply source, outside area 50' x 20', and appropriate tools

PERFORMANCE GUIDE

1. Locate trench lines considering desired amount of water overlap required for complete coverage.
2. Locate pipe, vertical tee and riser in trenches for each sprinkler head.
3. Locate supply line.

LEANING ACTIVITIES

1. Describe a typical lawn sprinkler system.
2. Explain why back flow protection is required.
3. Discuss the different types of spray patterns available in commercially manufactured sprinkler heads.
4. Explain how a pressure drop due to friction can affect the spray heads on the low end of the sprinkler system.
5. Arrange for the class to watch a sprinkler system being installed.
6. List the minimum pressures required for different sizes of sprinkler systems to operate correctly.
7. Describe methods used to protect the system against freezing.

RESOURCES

Blankenbaker. **Modern Plumbing**, pp. 238-244
Local plumbing code
Manufacturer's specifications

EVALUATION

Questions

1. Why is back siphonage/back flow protection needed on a lawn sprinkler system?
2. Why are manual drain valves installed at the low points of the sprinkler system?
   a. To prevent chemicals from entering the potable water supply
   b. To prevent the system from freezing
   c. So the sprinkler head can be adjusted
   d. To allow for thermal expansion

Answers

1. This protection is needed to prevent back flow of fertilizer and chemicals into the potable water supply.
2. b

Practical Application

Install a lawn sprinkler system with proper backflow protection.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 72 CHECKLIST

INSTALL LAWN SPRINKLER SYSTEM

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Install lawn sprinkler system with proper backflow protection. Clean work area and store tools properly.

DIRECTIONS TO EVALUTOR: Provide access to tools, equipment, and materials needed for the student to install a lawn sprinkler system. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Provided backflow protection		
2. Correctly spaced sprinkler heads		
3. Used correct size piping		
4. Placed manual drains at low points of system		
5. Placed specific pattern heads correctly		
6. Left work area clean and neat		

Suggested teaching time
4 periods

DUTY OR UNIT: WATER SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 73

TASK: Inspect plumbing system.

STANDARD: The inspection must cover pipe size use, location of piping, insulation drain line grading, and vent line sizing and location. All work must be in compliance with the contract and must meet all applicable codes.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A set of blueprints and building specifications, tools, equipment and plumbing supplies

PERFORMANCE GUIDE

1. Inspect vents and drain lines for compliance.
2. Inspect all water supply pipes for compliance.
3. Prepare report of inspection for instructor.

LEARNING ACTIVITIES

1. Arrange for class to visit the local inspection department.
2. Invite the local plumbing inspector to conduct a discussion on inspection procedures.
3. List the major items that will be checked during an inspection.
4. Emphasize the responsibility for public safety when inspecting a plumbing system.
5. Review some of the minimum venting requirements and sizes of the sanitary drainage system.
6. List some prohibited fittings.
7. Provide information on minimum grades of water and waste pipes.
8. Distribute a checklist for an inspection.

RESOURCES

Local plumbing code
Manufacturer's specifications
Local plumbing inspector

EVALUATION

Questions

1. What is the minimum slope required on a 3" diameter building drain?
2. At what temperature should a T & P relief valve for a domestic water heater be set?
3. Where are cleanouts required in the horizontal drainage system?
4. At what height must a relief vent connect back into the stack vent?

Answers

1. The minimum slope is 1/8" per foot.
2. Set the valve at 210° F.
3. Cleanouts are required at changes of direction greater than 45°.
4. The connection must be at a minimum of 6" above the flood level rim of the highest fixture on the stack.

PERFORMANCE OBJECTIVE V-TECS 73 continued

Practical Application
Inspect plumbing system. There are at least 11 items that should be identified and inspected.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 73 CHECKLIST

INSPECT PLUMBING SYSTEM

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

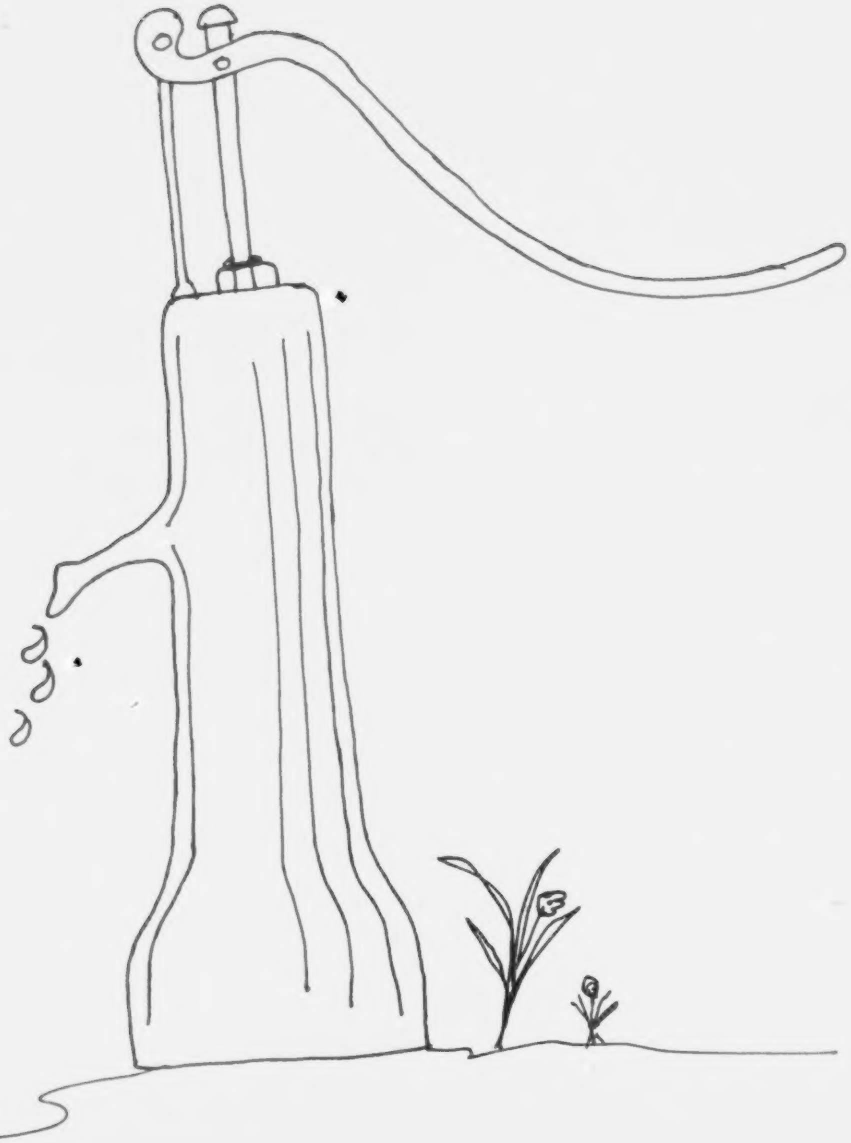
DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Inspect plumbing system. There are at least 11 items that should be identified and inspected.

DIRECTIONS TO EVALUATOR: Provide access to a plumbing system for the student to inspect. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
The inspection covered all these items.		
1. Layout planning		
2. Sizes		
3. Connections		
4. Elevation		
5. Venting		
6. Insulation		
7. Slopes		
8. Backflow protection		
9. Correct use of fittings		
10. Cleanouts		
11. Freezing protection		

PUMPS



Suggested teaching time
3 periods

DUTY OR UNIT: PUMPS

PERFORMANCE OBJECTIVE V-TECS 74

TASK: Install a well pump.

STANDARD: A domestic type water service pump must be installed in a simulated well situation. The work must adhere to existing codes and be functional.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Materials, tools, equipment, and plumbing supplies

PERFORMANCE GUIDE

1. Secure needed supplies, materials, and equipment.
2. Assemble and mount equipment with foot valve in open tank (simulated well).
3. Fill tank (simulated well).
4. Prime pump.
5. Make electrical connections.
6. Set pressure controls.
7. Start pump and check for leaks.

LEARNING ACTIVITIES

1. Explain the difference between deep and shallow wells.
2. Identify the basic types of pumps.
3. Discuss the operating cycles of reciprocating and centrifugal pumps.
4. Demonstrate priming a reciprocating pump.
5. Show the minimum distance allowed between a septic tank drain field and a fresh water well.
6. Arrange for the class to visit a well being bored and a pump being installed.
7. Describe the purpose and function of a pressure tank.
8. Explain the purpose of a foot valve.
9. Discuss sanitizing a fresh water well.
10. Explain pressure controls.
11. Show how to connect electrical power to pump motors.
12. Emphasize safety precautions when working around water and electricity.

RESOURCES

Blankenbaker. **Modern Plumbing**, pp. 180-191
Matthias and Smith. **How to Design and Install Plumbing**, pp. 256-262
Local plumbing code
Slater and Smith. **Advanced Plumbing**, pp. 67-70
Starbuck. **Sanitary Plumbing**, pp. 171-196
Local well and pump contractor

EVALUATION

Questions

1. A reciprocating pump uses an impeller as its principle driving force. (True or false)
2. What is the maximum practical lift of a reciprocating pump?
   a. 29'
   b. 25'
   c. 34'
   d. 40'

Answers

1. False
2. b

Practical Application

Install a well pump including the electrical connections. Joints and connections cannot leak.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 74 CHECKLIST

INSTALL A WELL PUMP

STUDENT'S NAME

EVALUATOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: Install a well pump including the electrical connections. Joints and connections cannot leak. Clean work area and store tools properly.

DIRECTIONS TO EVALUTOR: Provide access to tools, equipment, materials, and location needed for the student to install a well pump. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly assembled and mounted equipment with foot valve in well		
2. Correctly primed pump		
3. Installed pump electrical connections correctly		
4. Pump cuts in and out at proper settings		
5. Pump runs correctly		
6. Joints and connections do not leak		

Suggested teaching time
3 periods

DUTY OR UNIT: PUMPS

PERFORMANCE OBJECTIVE V-TECS 75

TASK: Install a sump pump.

STANDARD: A sump pump must be installed in a simulated situation in compliance with existing codes.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: Plumbing supplies, materials, equipment, and instructions

PERFORMANCE GUIDE

1. Secure supplies and materials.
2. Assemble equipment and place in sump.
3. Pipe discharge to suitable termination.
4. Install check valve in discharge line.
5. Connect power and test.

LEARNING ACTIVITIES

1. Discuss possible uses of sump pumps.
2. Explain how the float mechanism works.
3. Demonstrate how to position the pump in its sump and show the method of adjusting the liquid level.
4. Describe how and where to install a check valve in the discharge line if the pump terminates in a sanitary drain line.
5. Illustrate wiring procedures.
6. Establish safety precautions.

RESOURCES

Manufacturer's catalogs
Local plumbing code
Blankenbaker. **Modern Plumbing.** pp. 197-198

EVALUATION

Questions

1. What is the purpose of the float in a sump pump?
2. What precaution must be taken when connecting a sump pump discharge line into the sanitary drainage system?

Answers

1. When the water level rises in the sump, it raises the float which activates the pump motor switch.
2. A check valve must be installed in the discharge line to prevent the reverse flow of sanitary drainage waste into the sump.

Practical Application
Install a sump pump in compliance with all codes. Check electrical connections for safety.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 75 CHECKLIST

INSTALL A SUMP PUMP

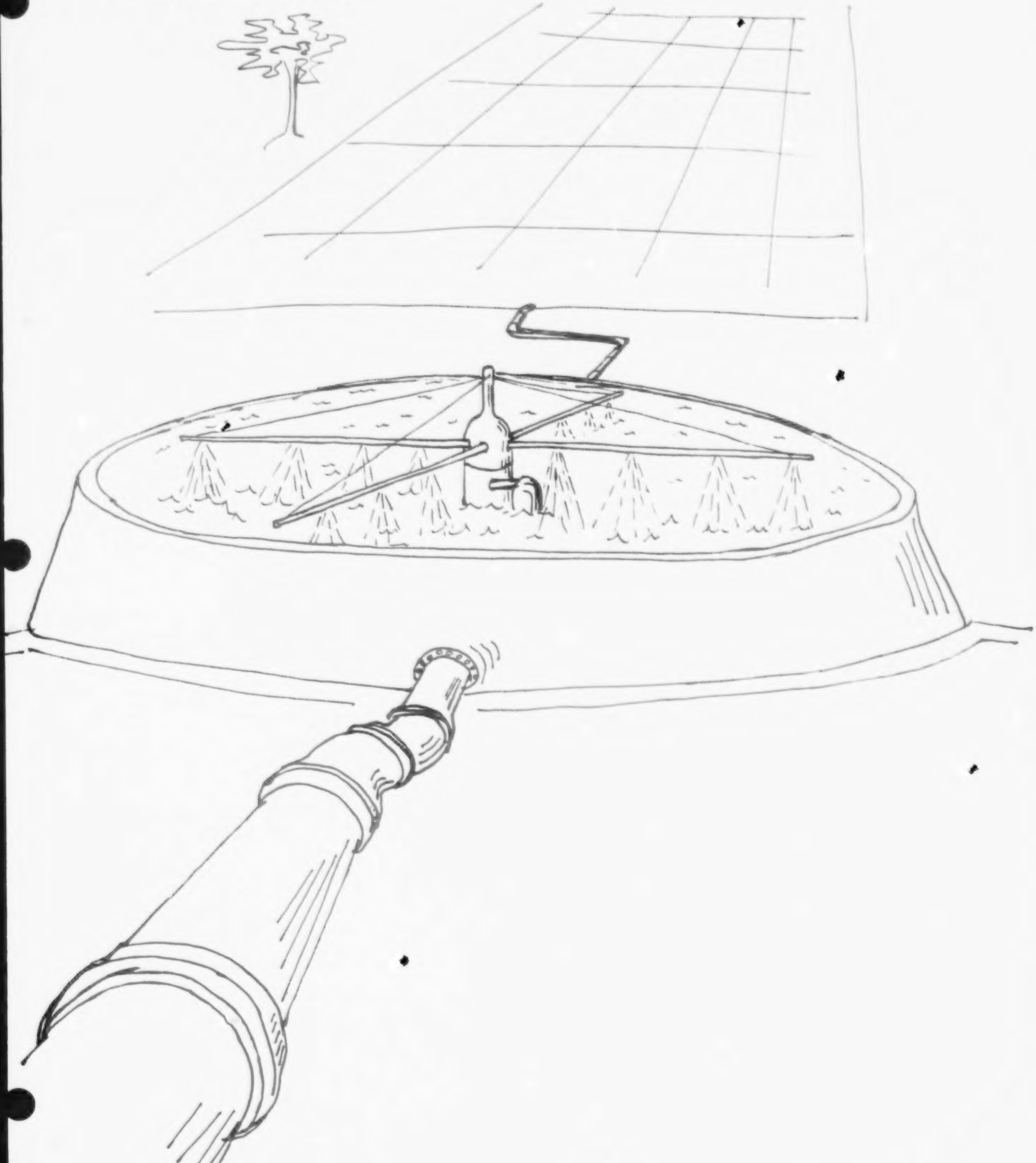
STUDENT'S NAME	EVALUATOR'S NAME
DATE	DATE

DIRECTIONS TO STUDENT: Install a sump pump in compliance with all codes. Check electrical connections for safety. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, materials, and location needed for the student to install a sump pump. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly assembled and placed pump on sump		
2. Correctly installed check valve		
3. Had electrical connections safe from shock		
4. Pump functioned correctly		
5. System does not leak		
6. Installation is in compliance with all codes		

DISPOSAL SYSTEMS



Suggested teaching time
3 periods

DUTY OR UNIT: DISPOSAL SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 76

TASK: Install septic tank and drain field.

STANDARD: The description of the procedures and functions of the installation of a septic tank and drain field must meet existing health requirements.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: The necessary information and specifications, tools and equipment.

PERFORMANCE GUIDE

1. Visit septic tank manufacturer.
2. Observe septic tank being cast or poured from concrete.
3. Visit site of actual septic tank and drain field installation.
4. Prepare written description.

LEARNING ACTIVITIES

1. Establish the number of occupants for a dwelling and calculate the cubic feet of septic tank storage needed.
2. Explain how the septic tank and drain field function.
3. Illustrate a typical tank and drain field including a distribution box.
4. Discuss how different types of soils affect the length of a drain field.
5. List the types of pipe suitable for drain fields.
6. Identify the major gases present during the septic cycle.
7. Explain the difference between aerobic and anaerobic bacteria.
8. Describe why the drain field must be close to the surface of the ground and away from tree roots.
9. Make sure the student understands that it can be fatal to climb into a septic tank after it has been pumped out for maintenance purposes and before a good supply of fresh air is introduced.
10. Arrange for the class to observe a septic tank system installation.

RESOURCES

Matthias and Smith. **How to Design and Install Plumbing,** pp. 20-32
Local plumbing code
Blankenbaker. **Modern Plumbing,** pp. 192-198
Local septic tank system contractor

Questions

1. Septic tanks should be located at least _____ from any well or other source of fresh water supply.
   a. 25'
   b. 50'
   c. 75'
   d. 100'
2. The most common gas formed in the decomposition of sewage is __________.
3. Septic tanks are usually constructed of what material?

Answers

1. b
2. Methane
3. Concrete is used in septic tanks.

Practical Application

A home is being built on a wooded lot (150' x 208'). The family of four selected the location because of the stream which flows along the lengthwise boundary line. Several of the pine trees which grow well in clay soil will have to be cut down to make room for the house and driveway. Draw a rough sketch of the lot and show a suitable location for the septic tank and drain field. Draw the placement of the potable well in relation to the septic tank.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 76 CHECKLIST

SEPTIC TANK AND DRAIN FIELD INSTALLATION

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: A home is being built on a wooded lot (150' x 208'). The family of four selected the location because of the stream which flows along the lengthwise boundary line. Several of the pine trees which grow well in clay soil will have to be cut down to make room for the house and driveway. Draw a rough sketch of the lot and show a suitable location for the septic tank and drain field. Draw the placement of the potable well in relation to the septic tank.

DIRECTIONS TO EVALUATOR: Provide the student with the complete information to draw the sketch. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Correctly figured cubic feet ratio to occupants		
2. Located tank fifty feet from source of fresh water		
3. Placed distribution box in correct location		
4. Correctly laid out drain field		
5. Installed gravel under drain field		

Suggested teaching time
3 periods

DUTY OR UNIT: DISPOSAL SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 77

TASK: Make sewer tap in vitrified clay sewer pipe.

STANDARD: A sewer tap must be made in a vitrified clay sewer pipe in compliance with all codes and health requirements.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Necessary tools, supplies and equipment

PERFORMANCE GUIDE

1. Cut 4½" hole in clay sewer line with hammer and chisel.
2. Cut bell to proper length.
3. Cement bell into hold.
4. Wear safety glasses.

LEARNING ACTIVITIES

1. Demonstrate how easily clay pipe is broken.
2. Discuss other methods of making sewer taps.
3. Explain why the building sewer should enter the upper portion of the main sewer.
4. Arrange for class to visit a sewer line being installed.
5. Provide information on safe working conditions in ditches.
6. Make class aware of how easily they can be hurt on broken pieces of clay pipe.
7. Caution students to wear safety glasses while cutting pipe with hammer and chisel.
8. Illustrate the problems created when sleeve connector protrudes too far into the main sewer.

RESOURCES

Slater. **Plumbing I**, pp. 113-114
Blankenbaker. **Modern Plumbing**, pp. 29, 121-133

EVALUATION

Questions

1. What is the best angle to tap into a main sewer?
2. What is the sand to cement ratio for applying to the sleeve connector?
3. A special precaution is needed when installing sewers in unstable ground conditions. What is this precaution?
4. Why must soil be put back carefully and tamped firmly?

Answers

1. 45°
2. The ratio is two parts sand to one part portland cement.
3. The ditches must be sloped or supported by bracing.
4. Soil must be replaced correctly to avoid breaking the clay pipe and stop it from settling unevenly.

PERFORMANCE OBJECTIVE V-TECS 77 continued

Practical Application
Make sewer tap in vitrified clay sewer pipe. Note all codes and health requirements.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 77 CHECKLIST

MAKE SEWER TAP IN VITRIFIED CLAY SEWER PIPE

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Make sewer tap in vitrified clay sewer pipe. Note all codes and health requirements. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, materials, and equipment needed for the student to make sewer tap in vitrified clay sewer pipe. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Cut 4½" hole in clay sewer line using hammer and chisel		
2. Cut bell to proper length		
3. Cemented bell into hole		
4. Work complied with all codes and health requirements		
5. Wore safety glasses		

Suggested teaching time
2 periods

DUTY OR UNIT: DISPOSAL SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 78

TASK: Classify public sewers.

STANDARD: The purpose of sewers from house or building to disposal plant must be identified and stated to the satisfaction of the instructor.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: Proper instructional materials

PERFORMANCE GUIDE

*1. Make a list of the different types of sewers.
*2. Describe the purpose of each sewer.

LEARNING ACTIVITIES

1. Explain how the tributary sewer receives the building sewer.
2. Describe the purpose of an intercepting sewer.
3. Illustrate the three basic shapes of intercepting sewers.
4. Explain why some deep sewers are installed in tunnels.
5. Explain the purpose of a manhole.
6. Explain how a combined sewer may cause problems at a disposal plant.
7. List safety precautions for working in deep trenches.
8. Illustrate a complete system including all the basic types of sewers from the building to the sewage treatment station.

RESOURCES

Matthias and Smith. **How to Design and Install Plumbing,** pp. 1-6
Ripka. **Plumbing Installation and Design,** pp. 17-21
Blankenbaker. **Modern Plumbing,** pp. 24-29

EVALUATION

Questions

1. What are the three basic shapes of intercepting sewers?
2. All trench shoring must be done with quality material free from ____________.
3. How do cities stop their intercepting sewers from becoming too deep in the ground when they are several miles long?

Answers

1. The three basic shapes are round, oval, and ovoid.
2. Defects
3. Occasional pumping at sewage lifting stations brings the sewage back up close to ground level.

*Steps for the Performance Guide were not given in the catalog. The South Carolina Curriculum Writing Team determined these steps as necessary to complete the task.

INSTALLING FIXTURES

Suggested teaching time
3 periods

DUTY OR UNIT: INSTALLING FIXTURES

PERFORMANCE OBJECTIVE V-TECS 79

TASK: Install bathtubs.

STANDARD: A bathtub must be installed so that it rests firmly on the floor against the wall and is level. The trim must not be scarred. All joints must be leakproof.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Rough-in plumbing and access to plumbing tools, equipment, and supplies

PERFORMANCE GUIDE

1. Remove tub from crate, if necessary, and inspect for chips or other damages.
2. Set tub in place.
3. Install 2" x 4" support to wall, secure tub apron on support, and level tub.
4. Connect waste and overflow, coating topside of tub waste flange with plumber's putty.
5. Using slip nuts and washers, connect waste and overflow to drain line provided.
6. Using trim provided by manufacturer, connect escutcheons and handles on faucets provided.
7. Using correct length nipple, install diverter spout flush with finished wall.
8. Turn water on and check for leaks on water supply and drain line connections.

LEARNING ACTIVITIES

1. Emphasize the importance of inspecting a tub that has not been uncrated.
2. Explain the importance of properly supporting and leveling a bathtub.
3. Demonstrate installing a 2" x 4" support to the wall.
4. Discuss and show the correct way to install a waste and overflow connection to a tub stub-out drain.
5. Demonstrate installing a bathtub and identifying the proper tools to use.
6. Show how to check for leaks on water supply and drain line connections.

RESOURCES

Barclay. **Residential Plumbing**, pp. 151, 152-F
Local plumbing code
Blankerbaker. **Modern Plumbing**, pp. 172-174

EVALUATION

Practical Application
Install a bathtub. Check for leaks.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 79 CHECKLIST

INSTALL BATHTUBS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Install a bathtub. Check for leaks. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for student to install a bathtub. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly supported and leveled tub		
2. Properly connected waste and overflow to tub and stubbed out drain		
3. Properly connected escutcheons and faucet handles		
4. Installed diverter spount properly (flush with finished wall)		
5. All joints and connections do not leak		

Suggested teaching time
2 periods

DUTY OR UNIT: INSTALLING FIXTURES

PERFORMANCE OBJECTIVE V-TECS 80

TASK: Install flush valve-type water closets.

STANDARD: A flush valve-type water closet must be installed so that plumbing fittings do not leak and the bowl rests securely on the floor. Chrome and porcelain parts must not be damaged during the installation.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Rough-in plumbing and access to plumbing tools, equipment and supplies

PERFORMANCE GUIDE

1. Install closet collar using lead and oakum joint.
2. Insert closet bolts into collar.
3. Place wax seal over closet collar.
4. Place closet bowl over drain outlet, inserting bolts through bowl holes provided.
5. Tighten closet bolts.
6. Using slip nut and washer, connect flush valve to bowl.
7. Using 1" chrome nipple for water line and chrome elbow provided, connect flush valve to water supply line.
8. Turn water supply on, flush water closet, and check operation of flush valve.
9. Adjust flush valve as required.
10. Check plumbing fittings for leaks.
11. Check bowl for stability; shim, if necessary.

LEARNING ACTIVITIES

1. Identify tools needed to install flush valve-type water closet.
2. Explain how this type water closet operates.
3. Explain the problems of an improperly installed water closet.
4. Demonstrate the procedure for installing the flush valve-type water closet.
5. Show how to check for leaks and bowl stability.

RESOURCES

Blankenbaker. **Modern Plumbing**, p. 179
Local plumbing code

EVALUATION

Practical Application
Install flush valve-type water closet. Check for leaks and bowl stability.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 80 CHECKLIST

INSTALL FLUSH VALVE-TYPE WATER CLOSETS

STUDENT'S NAME ____________________

EVALUATOR'S NAME ____________________

DATE ____________________

DATE ____________________

DIRECTIONS TO STUDENT: Install flush valve-type water closet. Check for leaks and bowl stability. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to install flush valve-type water closet. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly installed closet collar		
2. Placed closet bolts in flange slots		
3. Placed wax seal over closet collar		
4. Properly tightened closet bolts (not too tight so as to crack or break closet base)		
5. Properly connected water supply line		
6. Properly adjusted flush valve		
7. Joints and fittings do not leak		
8. Set commode level on floor		

Suggested teaching time
2 periods

DUTY OR UNIT: INSTALLING FIXTURES

PERFORMANCE OBJECTIVE V-TECS 81

TASK: Install tank-type water closets.

STANDARD: A tank-type water closet must be installed according to the manufacturer's instructions.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Rough-in plumbing and access to plumbing tools, equipment, and supplies

PERFORMANCE GUIDE

1. Remove water closet, tank, and accessories from crate and check flush valve.
2. Place bolts in closet bowl collar used to bolt bowl to floor.
3. Place wax seal over closet bowl collar.
4. Place closet bowl over drain line and bolt closet bowl to floor.
5. Connect closet tank to closet bowl using bolts, washers, and bushings provided. Tighten nuts on bolts alternately until washer exerts slight amount of pressure on bolts. Tank must be level on closet bowl.
6. Using water closet supply line, connect water supply line to closet tank.
7. Install closet bowl seat provided by placing bolts on seat through holes on closet bowl.
8. Tighten seat nuts carefully, so as not to crack ceramic closet bowl.
9. Turn water supply on and allow closet tank and bowl to fill.
10. Flush water closet and make adjustments on flush valve as required.
11. Check for leaks.
12. Place lid on closet tank.

LEARNING ACTIVITIES

1. Review the importance of carefully removing fixture and accessories from crate.
2. Discuss the difference between the tank-type water closet and the flush valve-type water closet.
3. Emphasize the safety precautions to follow and the careful handling of the ceramic bowl.
4. Demonstrate the procedure for installing a tank-type water closet.
5. Show how to check for leaks and clean up work area.

RESOURCES

Barclay. **Residential Plumbing**, pp. 86F-87F, 102F
Clifford. **The Encyclopedia of Household Plumbing**, p. 140
Blankenbaker. **Modern Plumbing**, pp. 176-177

EVALUATION

Practical Application

Install a tank-type water closet. Check for leaks.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 81 CHECKLIST

INSTALL TANK-TYPE WATER CLOSETS

STUDENT'S NAME ____________ EVALUATOR'S NAME ____________

DATE ____________ DATE ____________

DIRECTIONS TO STUDENT: Install a tank-type water closet according to specifications. Check for leaks. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to install a tank-type water closet. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. No leakage in closet bowl and tank connections		
2. Connections to water supply do not leak		
3. Floor drain connection does not leak		
4. Tank and closet bowl fill with water when water supply is turned on and after flushing		
5. Secured bowl to floor		
6. Tank rests level on closet bowl		

Suggested teaching time
3 periods

DUTY OR UNIT: INSTALLING FIXTURES

PERFORMANCE OBJECTIVE V-TECS 82

TASK: Install built-in lavatories.

STANDARD: A built-in lavatory must be installed so that pipe connections and faucets do not leak and sink is level. Chrome accessories must not be damaged.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Rough-in plumbing and access to plumbing tools, equipment, and supplies

PERFORMANCE GUIDE

1. Coat inside edge of rim with fixture sealant.
2. Fit lavatory into cavity.
3. Attach lavatory to rim using clips provided.
4. Coat flange of pull-out plug with plumber's putty and set plug in lavatory.
5. Coat faucet flanges with plumber's putty and connect faucets to lavatory.
6. Using correct length lavatory supplies, connect water supply line to lavatory.
7. Using P-trap and 1¼" x 1½" slip joint nut, connect drain line to lavatory.
8. Turn on water supply and check connections and faucets for leaks.

LEARNING ACTIVITIES

1. Explain the importance of coating the rim of the fixture with sealant.
2. Identify the tools needed to install a built-in lavatory.
3. Using a diagram or manufacturer's specifications, show how the lavatory is fitted into the cavity and the measurements needed.
4. Demonstrate installing a built-in lavatory with several students helping. Have other students verbally describe the steps during the installation.
5. Show how to check for leaks.

RESOURCES

Barclay. **Residential Plumbing**, p. 129F
Clifford. **Encyclopedia of Household Plumbing**, pp. 164-165
Blankenbaker. **Modern Plumbing**, pp. 167-171

EVALUATION

Practical Application
Install a built-in lavatory. Check for leaks.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 82 CHECKLIST

INSTALL BUILT-IN LAVATORIES

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Install a built-in lavatory according to specifications. Check for leaks. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to install built-in lavatory. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Correctly applied fixture sealant to inside edge of rim		
2. Properly fitted lavatory into cavity		
3. Attached lavatory to rim, using clips		
4. Properly connected pull-out plug, faucet flanges and faucets		
5. Properly connected water supply and drains to lavatory		
6. Removed all excess putty, etc		
7. Joints and connections do not leak		

Suggested teaching time
3 periods

DUTY OR UNIT: INSTALLING FIXTURES

PERFORMANCE OBJECTIVE V-TECS 83

TASK: Install wall-mounted lavatories.

STANDARD: The installation of a wall-mounted lavatory must be done so that it is level and in a sturdy position, fitting joints do not leak, and water drains freely. Chrome fittings and faucets must not be scarred.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMNACE OF TASK: Rough-in plumbing and access to tools, equipment, and supplies

PERFORMANCE GUIDE

1. Remove lavatory from crate, if necessary, and inspect for damage.
2. Determine height of installation.
3. Install hanger at correct height.
4. Connect lavatory faucets. Use plumber's putty between seat of faucets and surface of lavatory.
5. Using nuts and washers provided by manufacturer, tighten faucets snugly on lavatory.
6. Remove flange from drain plug and coat underside with plumber's putty.
7. Drop drain plug flange through lavatory drain hole.
8. Using material furnished by the manufacturer, tighten drain plug snugly in lavatory.
9. Secure lavatory on hanger previously installed.
10. Using correct length lavatory piping supplies, connect cold water supply to cold water side of faucets.
11. Connect hot water supply to hot water side of faucets.
12. Using 1 ¼" P-trap, and 1 ½" x 1 ¼" slip nut and washer, install trap to drain line provided.
13. Turn water on and check for leaks in water supply and drain line connections.

LEARNING ACTIVITIES

1. Identify the differences in installing a built-in lavatory and installing a wall-mounted lavatory.
2. Review the purpose of plumber's putty and how to use it.
3. Review the manufacturer's specifications for installing wall-mounted lavatory.
4. Demonstrate installing wall-mounted lavatory with the help of the students.
5. Show where to check for leaks.

RESOURCES

Barclay. **Residential Plumbing**, p. 145F
Blankenbaker. **Modern Plumbing**, pp. 166-168

EVALUATION

Practical Application
Install a wall-mounted lavatory. Check for leaks.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 83 CHECKLIST

INSTALL WALL-MOUNTED LAVATORIES

STUDENT'S NAME EVALUATOR'S NAME

DATE DATE

DIRECTIONS TO STUDENT: Install a wall-mounted lavatory according to specifications. Check for leaks. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provode access to tools, equipment, and materials needed for the student to install wall-mounted lavatory. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Installed hanger at correct height		
2. Properly installed faucets on lavatory		
3. Properly installed drain flange and plug on lavatory		
4. Securely fastened lavatory to hanger		
5. Properly connected hot and cold supply lines to faucets		
6. Properly connected drain line to lavatory		
7. Supply and drain lines do not leak		

Suggested teaching time
2 periods

DUTY OR UNIT: INSTALLING FIXTURES

PERFORMANCE OBJECTIVE V-TECS 84

TASK: Install wall-mounted urinals.

STANDARD: The installation of a wall-mounted urinal must be done so that it fits flush against the wall and in a plumb position. The fitting joints must not leak and the fixture must flush correctly when flush valve is activated.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Rough-in plumbing and access to tools, equipment, and supplies

PERFORMANCE GUIDE

1. Install drain bracket on drain line which has been stubbed out through wall.
2. If urinal has hangers, install hangers at correct height from finished floor.
3. If ceramic tile wall exists, drill hole through ceramic wall and use toggle bolts to bolt bracket to wall.
4. Bolt urinal to finished wall, using bolts and holes in the urinal provided by manufacturer.
5. Install flush valve, using chrome elbow and nipples provided by manufacturer.
6. Turn water on and adjust flush valve for correct water pressure.

LEARNING ACTIVITIES

1. Using a diagram, show how the wall-mounted urinal operates.
2. Identify the tools needed and their purpose in installing the urinal and the type of tools needed for use on chrome fittings.
3. Explain the precautions used when installing on a ceramic tile wall.
4. Demonstrate the installation of a wall-mounted urinal. Have several students helping and other students verbally describing the steps involved.
5. Show how to adjust flush valve for correct water pressure.

RESOURCES

Local plumbing code
Manufacturer's specifications
Blankenbaker. **Modern Plumbing**, pp. 63-64, 178-179

EVALUATION

Practical Application
Install a wall-mounted urinal. Check for correct water pressure.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 84 CHECKLIST

INSTALL WALL-MOUNTED URINALS

STUDENT'S NAME

EVALUATOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: Install a wall-mounted urinal according to specifications. Check for correct water pressure. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to install wall-mounted urinal. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly installed drain bracket on drain line.		
2. Installed hangers at correct height from floor.		
3. Properly bolted urinal to hangers.		
4. Properly installed flush valve.		
5. Correctly adjusted flush valve.		
6. Joints and connections do not leak.		

Suggested teaching time
2 periods

DUTY OR UNIT: INSTALLING FIXTURES

PERFORMANCE OBJECTIVE V-TECS 85

TASK: Install shower bath accessories in ceramic tile baths.

STANDARD: Installation of shower bath accessories in a ceramic tile bath must be completed according to specifications.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Rough-in plumbing and tool set including strap wrench and shower bath accessories

PERFORMANCE GUIDE

1. Place small amount of plumber's putty on control valve heads and shower pipe stub.
2. Attach shower head and valve to shower pipe.
3. Slide escutcheon onto shower pipe.
4. Attach shower pipe end to roughed-in wall stub.
5. Press escutcheon against wall covering hole and stub. (Putty will hold escutcheon in place.)
6. Place escutcheon over water contol valves and press against wall.
7. Attach control valve handles with screwdriver.

LEARNING ACTIVITIES

1. Emphasize the safety precautions used in handling shower bath accessories and working on ceramic tile.
2. Show how to read specifications for placement of accessories.
3. Demonstrate the procedure in installing shower bath accessories. Have the students describe the procedure.
4. Show how to putty around the accessories and explain the need for putty.
5. Identify where leaks may occur and how to correct a leak after work is completed.

RESOURCES

Barclay. **Residential Plumbing**, p. 155F

EVALUATION

Practical Application
Install shower bath accessories in ceramic tile bath. Check for leaks.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 85 CHECKLIST

INSTALL SHOWER BATH ACCESSORIES IN CERAMIC TILE BATHS

STUDENT'S NAME	EVALUATOR'S NAME
DATE	DATE

DIRECTIONS TO STUDENT: Install shower bath accessories in ceramic tile bath according to specifications. Check for leaks. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to install shower bath accessories in ceramic tile bath. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Did not scar chrome finish of trim		
2. Faucet flange fit flush against finished wall and was leakproof		
3. Fit shower pipe flange flush against finished wall and sealed		
4. Shower pipe and lead connections to water supply do not leak		

Suggested teaching time
3 periods

DUTY OR UNIT: INSTALLING FIXTURES

PERFORMANCE OBJECTIVE V-TECS 86

TASK: Install kitchen sink.

STANDARD: A kitchen sink must be installed so that pipe connections and faucets do not leak and the sink is level. Chrome accessories must not be damaged.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: Rough-in plumbing and access to plumbing tools, equipment, and supplies

PERFORMANCE GUIDE

1. Coat inside edge of rim with fixture sealant.
2. Fit sink into cavity.
3. Attach sink to rim using clips provided.
4. Coat flange of pull-out plug with plumber's putty and set strainer baskets in sink.
5. Coat faucet flanges with plumber's putty and connect faucets to sink.
6. Using correct length sink supplies, connect water supply line to sink.
7. Using P-trap and 1½" slip joint nut, connect drain line to sink.
8. Turn on water supply and check connections and faucets for leaks.

LEARNING ACTIVITIES

1. Using a diagram or teacher-made transparency, illustrate how the kitchen sink fits into the cavity and the hook-ups needed for operation.
2. Explain the positions of hot and cold water pipes.
3. Show pictures of several types of faucets and styles of sinks and describe how each is different.
4. Demonstrate installing a kitchen sink with the aid of students.
5. Demonstrate what happens when incorrect lengths of supplies are used, the expense of miscalculations, and how one problem may affect another, i.e., dishwasher, garbge disposal, etc.

RESOURCES

Local plumbing code
Blankenbaker. **Modern Plumbing**, pp. 186-187
Barclay. **Residential Plumbing**, p. 181F

EVALUATION

Practical Application
Install a kitchen sink. Check for leaks.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 86 CHECKLIST

INSTALL KITCHEN SINK

STUDENT'S NAME ____________________

EVALUATOR'S NAME ____________________

DATE ____________________

DATE ____________________

DIRECTIONS TO STUDENT: Install a kitchen sink according to specifications. Check for leaks. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to install kitchen sink. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Did not scar chrome finish of trim		
2. Sealed rim to sink and rim to counter top		
3. Installed faucet square to wall and sink		
4. Properly shaped supply lines		
5. Had leaks in water supply or drainage connections		
6. Properly spaced and tightened mounting brackets		
7. Puttied strained baskets and seated properly in sink		
8. Kept work area clean and returned tools to proper location		

Suggested teaching time
2 periods

DUTY OR UNIT: INSTALLING FIXTURES

PERFORMANCE OBJECTIVE V-TECS 87

TASK: Install garbage disposal units.

STANDARD: The garbage disposal unit must be installed so that no joints leak.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A cabinet-mounted sink, a garbage disposal unit, and appropriate tools, fittings and materials

PERFORMANCE GUIDE

1. Remove sink tailpipe and loosen strainer.
2. Position disposal unit directly under sink drain.
3. Screw strainer into top of unit and secure with lock nut.
4. Insert fitting into disposal unit and attach trap with cleanout.
5. Secure both with lock nuts.
6. Inspect for leaks.
7. Call electrician for connecting power to unit.

LEARNING ACTIVITIES

1. Explain the operation of a garbage disposal.
2. Show pictures of the different types of garbage disposal units.
3. Identify the tools needed to install the unit.
4. Demonstrate the procedure for installing the garbage disposal unit. Have a student describe the procedure.
5. Emphasize the importance of inspecting for leaks and explain how to correct a leakage after installation.
6. Ask the electricity teacher to show the class how the power is connected to the unit and the importance of having an electrician complete this part of the installation.

RESOURCES

Barclay. **Residential Plumbing,** p. 161F
Blankenbaker. **Modern Plumbing,** p. 172

EVALUATION

Practical Application
Install a garbage disposal unit. Check for leaks.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 87 CHECKLIST

INSTALL GARBAGE DISPOSAL UNITS

STUDENT'S NAME ____________ EVALUATOR'S NAME ____________

DATE ____________ DATE ____________

DIRECTIONS TO STUDENT: Install a garbage disposal unit according to specifications. Check for leaks. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to install a garbage disposal unit. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Positioned disposal unit correctly under sink drain.		
2. Secured strainer with lock nut.		
3. Properly installed all fittings and secured with lock nuts.		
4. Joints and drains do not leak.		

Suggested teaching time
3 periods

DUTY OR UNIT: INSTALLING FIXTURES

PERFORMANCE OBJECTIVE V-TECS 88

TASK: Install dishwashers.

STANDARD: A dishwasher must be installed so that drain connections to the kitchen sink and water supply line do not leak. The drain line must prevent backfill from the sink drain line.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Rough-in plumbing manufacturer's installation manual and an access to plumbing tools, equipment and supplies

PERFORMANCE GUIDE

1. Remove cover from back of dishwasher, if required.
2. Identify hot water outlet on dishwasher.
3. Make up and connect hot water line from dishwasher to hot water supply line, using copper tubing and fittings.
4. Install cut-off valve on hot water supply line.
5. Using dishwasher sink connector, install dishwasher drain line. (Drain line must have a loop to prevent sink drain backup into dishwasher.)
6. Replace cover on back of dishwasher.
7. Set dishwasher in place and level, using leveling legs provided on dishwasher.
8. Turn water supply on and cycle machine completely.
9. Check flow of water during cycle for obstructions and leaks.

LEARNING ACTIVITIES

1. Explain the operation of a dishwasher.
2. Show pictures of the different models and makes of dishwashers.
3. Explain the plumbing needed for dishwasher in relation to other appliances, i.e., sink, garbage disposal, etc.
4. Demonstrate how to install a dishwasher with students helping.
5. Have a student turn on the water supply and operate the dishwasher while checking for leaks.

RESOURCES

Barclay. **Residential Plumbing**, p. 159F
Manufacturer's specifications
Local plumbing code

EVALUATION

Practical Application
Install dishwasher. Check for leaks.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 88 CHECKLIST

INSTALL DISHWASHERS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Install a dishwasher according to specifications. Check for leaks. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials for the student to install a dishwasher. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly identified and connected hot water supply line		
2. Installed shut-off valve in hot water supply line		
3. Properly installed dishwasher drain line		
4. Properly set dishwasher in place and leveled		
5. Supply and drain lines do not leak		
6. Checked dishwasher for proper operation, i.e. cycles properly and drains completely		

Suggested teaching time
3 periods

DUTY OR UNIT: INSTALLING FIXTURES

PERFORMANCE OBJECTIVE V-TECS 89

TASK: Install drinking fountains.

STANDARD: The drinking fountain must be installed in a sanitary condition and rest securely in place. The height and/or location must be within + 1/2" of specifications. The fountain must be level and connections must be leakproof.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Rough-in plumbing and access to plumbing tools, equipment, and supplies

PERFORMANCE GUIDE

1. Using 3/8" copper tubing and fittings, connect cold water supply line to drinking fountain.
2. Using 1 1/4" trap and 1 1/2" x 1 1/4" slip joint nut and washer, connect drain line to drinking fountain.
3. Mount fountain securely to wall, if wall-hung type.
4. Turn water supply on and adjust height of water flow on drinking fountain.
5. Level drinking fountain, if necessary.
6. Check all fittings on drain and water supply line for leaks.
7. Clean water fountain and working area.

LEARNING ACTIVITIES

1. Review the manufacturer's specifications for installing a drinking fountain.
2. Explain why it is necessary for the drinking fountain to be level.
3. Using diagram, illustrate the plumbing needed for the installation.
4. Identify the tools needed for the installation.
5. Demonstrate the procedure for installing a drinking fountain with students helping.
6. Emphasize the importance of cleaning up the work area and storing tools in their proper place.

RESOURCES

Blankenbaker. **Modern Plumbing**, pp. 81, 178-179
Local plumbing code

EVALUATION

Practical Application
Install a drinking fountain. Check for leaks.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 89 CHECKLIST

INSTALL DRINKING FOUNTAINS

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Install a drinking fountain according to specifications. Check for leaks. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to install a drinking fountain. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly connected cold water supply		
2. Properly installed drain line		
3. Properly mounted and leveled fountain		
4. Correctly adjusted height of water flow		
5. All joints and fittings are leakproof		
6. Cleaned fountain and work area		

Suggested teaching time
1 period

DUTY OR UNIT: INSTALLING FIXTURES

PERFORMANCE OBJECTIVE V-TECS 90

TASK: Install pressure relief valves.

STANDARD: A pre-set pressure relief valve on a hot water heater must be installed in a safe drainage position and so that pipe joints do not leak.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A hot water heater, pressure relief valve, supplies and tools

PERFORMANCE GUIDE

1. Apply pipe sealant to male threads of one pipe stub atop heater (either hot or cold as determined by local codes).
2. Attach tee to stub and tighten with wrenches.
3. Using sealant and wrenches, attach nipple to top of tee.
4. Attach relief valve to nipple end and tighten, with relief valve opening positioned for desired direction of drain off.
5. Attach drain pipe to relief valve opening.
6. Connect piping to tee for remaining water supply as determined in Step 1.

LEARNING ACTIVITIES

1. Explain the purpose of pressure relief valves.
2. Identify where the valve is installed on a hot water heater.
3. Demonstrate how to install pressure relief valve on a hot water heater.
4. Describe problems when valve is installed incorrectly.
5. Explain the importance of cleaning up work area and storing the tools.

RESOURCES

Blankenbaker. **Modern Plumbing**, p. 78
Local plumbing code

EVALUATION

Practical Application
Install a pressure relief valve on a hot water heater.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 95% accuracy.

PERFORMANCE OBJECTIVE V-TECS 90 CHECKLIST

INSTALL PRESSURE RELIEF VALVES

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Install a pressure relief valve on a hot water heater according to specifications. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to install a pressure relief valve. Observe the student. Accuracy of 95% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Installed relief valve in proper location.		
2. Properly installed drain pipe and ran it to termination point.		
3. All joints do not leak.		

Suggested teaching time
4 periods

DUTY OR UNIT: INSTALLING FIXTURES

PERFORMANCE OBJECTIVE V-TECS 91

TASK: Install electric water heaters.

STANDARD: The plumbing must be installed so that the cover can be placed on the water heater and the heater elements and thermostats are easily accessible. All pipe joints must be leakproof.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Rough-in plumbing and access to plumbing tools, equipment and supplies

PERFORMANCE GUIDE

1. Remove top from water heater.
2. Install relief valve from opening at top of water heater. Relief valve must be positioned according to safety regulations.
3. Connect hot water supply line to opening designated on water heater, including a dialectric union.
4. Install hot water line in channel provided at back of water heater.
5. Connect cold water outlet to cold water opening on water heater, including a union.
6. Install cold water line in channel provided at back of water heater.
7. Level water heater.
8. Turn on hot water faucet at kitchen sink and turn on water supply.
9. Fill water heater until water flows from hot water faucet in kitchen sink.
10. Cut off hot water faucet in kitchen.
11. Check hot and cold water supply lines for leaks.
12. Replace top of water heater.
13. Turn on electricity.

LEARNING ACTIVITIES

1. Explain the operation of an electric water heater and its parts.
2. Describe the advantages and disadvantages of an electric water heater.
3. Review the manufacturer's specifications for installing the heater.
4. Demonstrate the procedure for installing an electric water heater and have the students help.
5. Emphasize the safety precautions used in installing an electrical appliance.

RESOURCES

Barclay. **Residential Plumbing**, p. 157F
Blankenbaker. **Modern Plumbing**, pp. 74-77

EVALUATION

Practical Application
Install an electric water heater.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 95% accuracy.

PERFORMANCE OBJECTIVE V-TECS 91 CHECKLIST

INSTALL ELECTRIC WATER HEATERS

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Install an electric water heater. Follow all safety rules. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to install an electric water heater. Observe the student. Accuracy of 95% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly located water heater		
2. Connected supply lines to proper tank outlets		
3. Installed cut-off valve in cold water supply line		
4. Located boiler drain in proper position and closed		
5. Properly installed relief valve and ran drain line to proper termination		
6. All lines are secure and do not leak		

Suggested teaching time
4 periods

DUTY OR UNIT: INSTALLING FIXTURES

PERFORMANCE OBJECTIVE V-TECS 92

TASK: Install gas water heaters.

STANDARD: A gas water heater must be installed according to specifications.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Rough-in plumbing and access to plumbing tools, equipment and supplies

PERFORMANCE GUIDE

1. Locate relief valve outlet on water heater and attach tee to stub.
2. Install relief valve.
3. Attach 3/4" galvanized line from relief valve to location of desired overflow.
4. Using nipple, elbow, and union, install 3/4" galvanized line from heater to cold water supply line.
5. Using nipple, elbow, and union, install 3/4" galvanized line from heater to hot water supply line.
6. Using 3" galvanized vent pipe, run vent through roof or wall. (Use double-wall pipe where vent extends through combustible material.)
7. If vent protrudes through roof, install 3" roof jack to prevent leaks around pipe outlet.
8. Place cap over vent pipe outlet.
9. Using required pipe and fittings connect gas line to heater.
10. Turn gas supply on and check for leaks, using soap and water solution as leak detector.
11. Open hot water faucet in kitchen sink.
12. Turn water supply on.
13. Fill hot water tank until water flows from hot water faucet in kitchen sink.
14. Cut off hot water faucet in kitchen.
15. Check hot water and cold water supply lines for leaks.
16. Light hot water heater and adjust burner flame, if necessary.

LEARNING ACTIVITIES

1. Identify the parts of a gas water heater.
2. Explain the difference between an electric water heater and a gas water heater and the economy of operating each.
3. Describe the advantages and disadvantages of a gas water heater.
4. Demonstrate the installation of a gas water heater.
5. Emphasize the safety precautions to follow when connecting a gas line to heater.
6. Show how to check for leaks and what to do if there is a leak.
7. Illustrate how to install the exhaust gases flue pipe showing fire safety clearances.
8. Explain the combustion air requirements.

PERFORMANCE OBJECTIVE V-TECS 92

RESOURCES
Barclay. **Residential Plumbing**, p. 163P
Blankenbaker. **Modern Plumbing**, p. 78
Local plumbing code
Local gas code

EVALUATION
Practical Application
Install a gas water heater. Check for leaks.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 95% accuracy.

PERFORMANCE OBJECTIVE V-TECS 92 CHECKLIST

INSTALL GAS WATER HEATERS

STUDENT'S NAME ______________ EVALUATOR'S NAME ______________

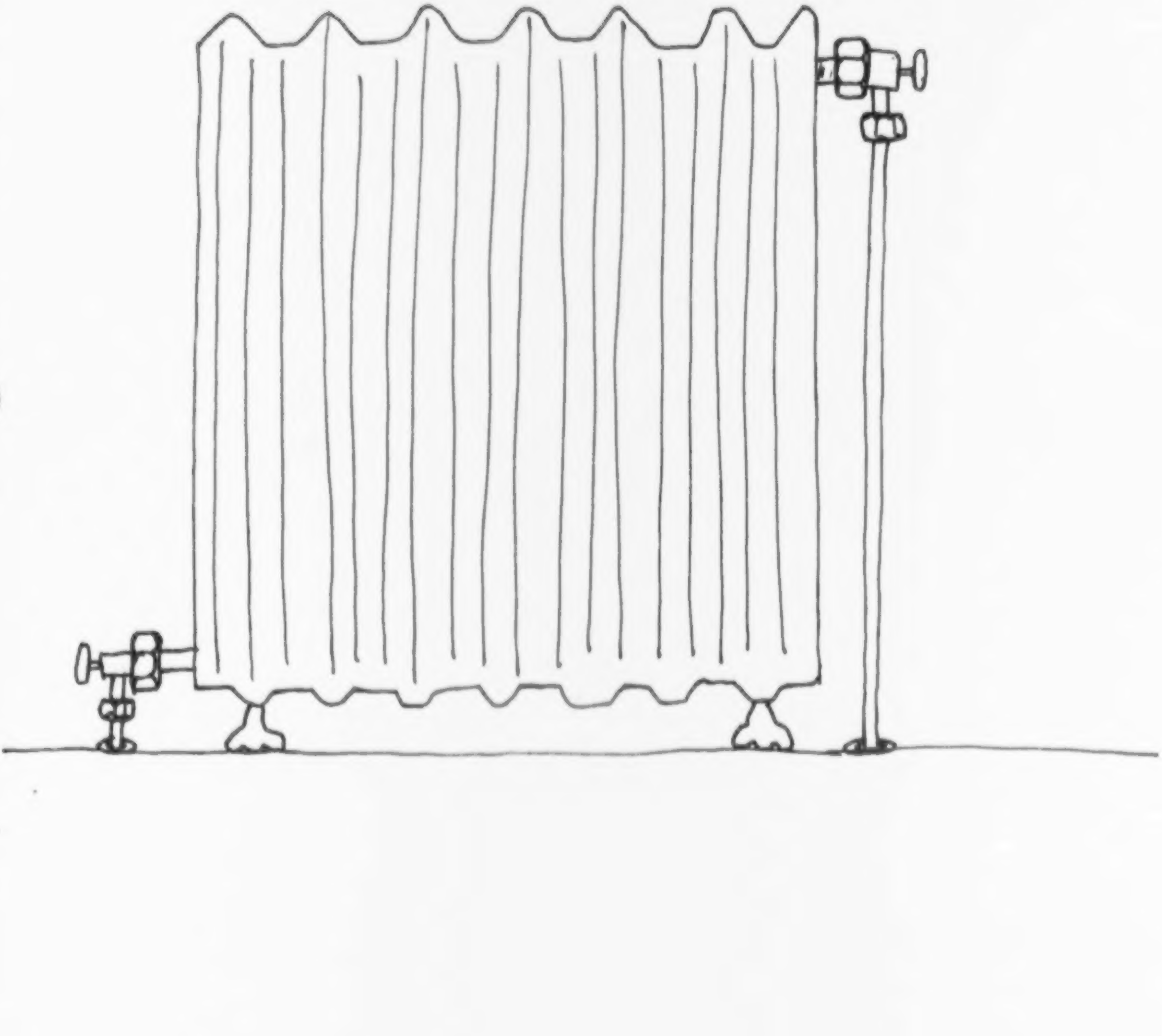
DATE ______________ DATE ______________

DIRECTIONS TO STUDENT: Install a gas water heater according to specifications. Follow all safety rules. Check for leaks. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to install a gas water heater. Observe the student. Accuracy of 95% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Positioned vent pipe properly		
2. Roof flashing prevented water leaks		
3. Properly adjusted hot water heater burner flame		
4. Hot and cold water supply lines do not leak		
5. Installed hot water heater in a stable position		
6. Properly installed relief valve outlet		
7. Positioned heater for accessible maintenance		

HEATING SYSTEMS



Suggested teaching time
3 periods

DUTY OR UNIT: HEATING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 93

TASK: Install water system components for hot water heating coils.

STANDARD: Construction and installation of water lines for a hot water heating coil must be free of obstructions and joints must not leak.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Black steel pipe, appropriate fittings, plumbing tools, and a description of the construction and installation requirements, real or simulated heating coils, and boiler

PERFORMANCE GUIDE

1. Connect pipe to main supply line.
2. Connect balancing valve in supply line.
3. Attach gate valve on return line.
4. Install gauge cock.
5. Connect thermometer well in return and supply line.
6. Install by-pass line into three-way valve.
7. Install unions as necessary.
8. Install drain tee.
9. Connect pipe out of coil and into return port on three-way valve.
10. Install strainer ahead of coil and three-way valve.

LEARNING ACTIVITIES

1. Describe how the water is heated and circulated through the system.
2. Explain the purpose of a balancing valve.
3. Demonstrate the installation of a thermometer well.
4. Illustrate the position and piping arrangement to the three-way valve.
5. Emphasize the need for periodic draining of sediment.
6. Arrange for class to view a hot water heating coil system.

RESOURCES

Local mechanical code
Starbuck. **Steam and Hot Water Heating,** pp. 105-112, 161-166
Starbuck. **Sanitary Plumbing Hot Water Supply and Circulation,** pp. 88-99, 152-178
Blankenbaker. **Modern Plumbing,** pp. 205-214
Slater and Smith. **Advanced Plumbing,** pp. 167-169

EVALUATION

Questions

1. What are the two classes of hot water heating systems?
2. What is the purpose of an air vent in a hot water heating system?

Answers

1. The two classes are gravity systems and forced circulation systems.
2. The air vent releases trapped air from the high points in the system to allow the unrestricted circulation of the hot water.

PERFORMANCE OBJECTIVE V-TECS 93 continued

Practical Application
Install the water system components for hot water heating coils.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 93 CHECKLIST

INSTALL WATER SYSTEM COMPONENTS FOR HOT WATER HEATING COILS

STUDENT'S NAME

EVALUATOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: Install the water system components for hot water heating coils according to specifications. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to install water system components for hot water heating coils. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly located all components.		
2. No leakage in any joints.		

Suggested teaching time
2 periods

DUTY OR UNIT: HEATING SYSTEMS

PERFORMANCE OBJECTIVE V-TECS 94

TASK: Install temperature and pressure relief valves on boilers.

STANDARD: The temperature and pressure relief valve on a boiler must allow system/water release under a pressure and temperature test of the boiler.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A boiler with a relief port, needed tools and equipment

PERFORMANCE GUIDE

1. Attach temperature and pressure relief valve furnished by boiler manufacturer to relief port.
2. Connect pipe to valve and run to nearest drain opening.
3. Check relief of boiler water, using the manual trip lever.
4. Fire boiler to temperature and pressure required for activation of valve. Valve must relieve at pressure and temperature indicated.

LEARNING ACTIVITIES

1. Explain the purpose of a temperature and pressure relief valve (T & P valve).
2. Describe how a temperature increase in a closed system increases the pressure of a liquid.
3. Demonstrate the trip lever function.
4. Identify the thermo bulb.
5. Show how the pressure spring works.
6. Emphasize the importance of running the discharge line from the T & P valve full size and without valves or trapping.
7. Discuss what could happen if a T & P valve was not installed on a boiler.

RESOURCES

Local plumbing code
Starbuck. **Hot Water Supply and Circulation** (Vol. II), pp. 152-161
Blankenbaker. **Modern Plumbing,** pp. 64-65
Slater and Smith. **Advanced Plumbing,** pp. 155-160
Ripka. **Plumbing Installation and Design,** pp. 238-240

EVALUATION

Questions

1. What causes an explosion in a hot water system?
2. Why should T & P valves be opened occasionally by hand?
    a. The boiler needs flushing out.
    b. The valve spring should be stretched.
    c. Corrosion may have made the valve inoperative.
    d. The valve washers need to be dampened occasionally.

Answers

1. An explosion is caused by the overheated water suddenly expanding to steam when exposed to atmospheric pressure.
2. c

Practical Application

Install a temperature and pressure relief valve on a boiler according to specifications.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 94 CHECKLIST

INSTALL TEMPERATURE AND PRESSURE RELIEF VALVES ON BOILERS

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

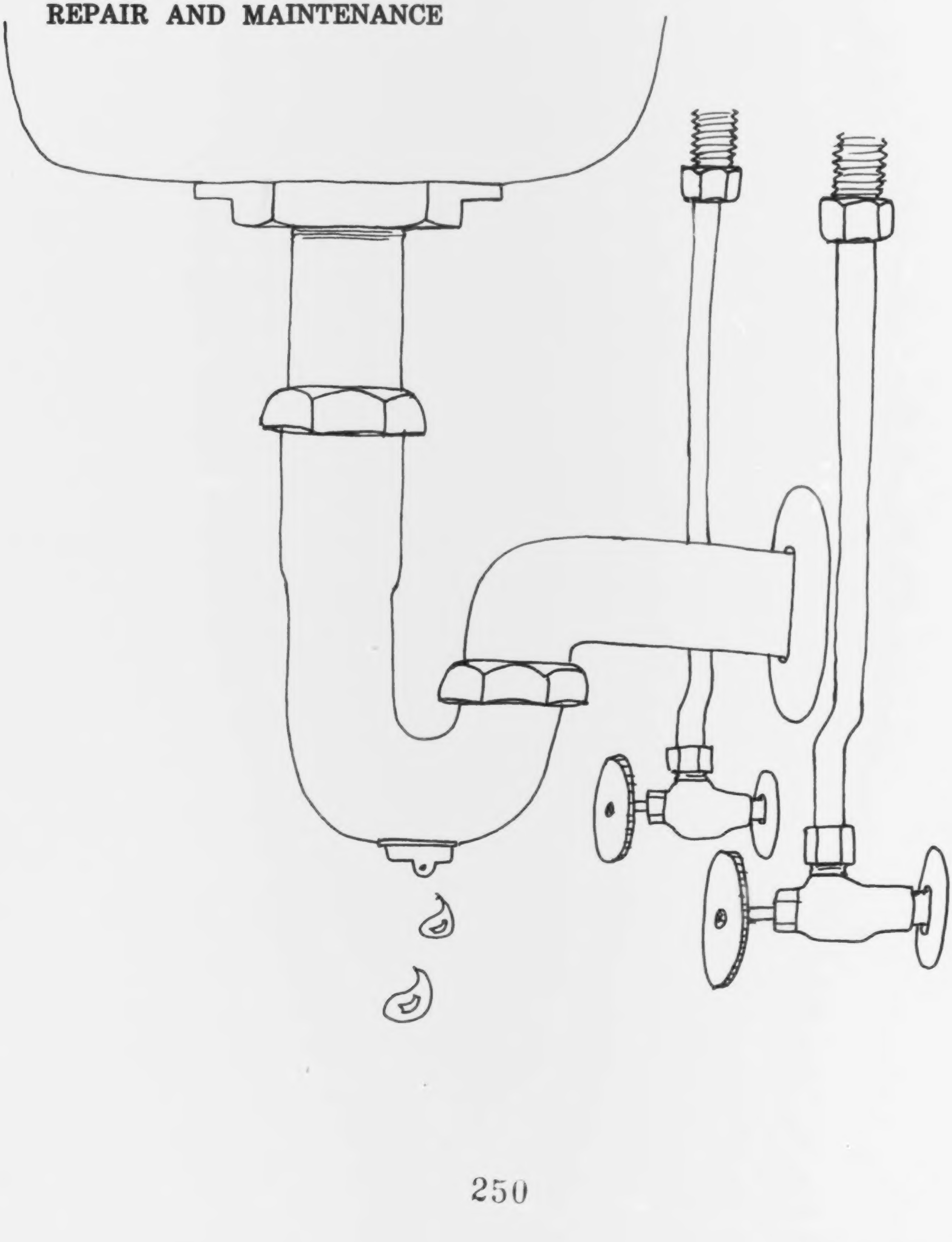
DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Install a temperature and pressure relief valve on a boiler according to specifications. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to install temperature and pressure relief valves on a boiler. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly located pressure relief valve.		
2. Ran drain to proper outlet.		
3. Checked system so that relief valve operates at correct temperature and pressure.		

REPAIR AND MAINTENANCE



Suggested teaching time
4 periods

DUTY OR UNIT: REPAIR AND MAINTENANCE

PERFORMANCE OBJECTIVE V-TECS 95

TASK: Trouble shooting plumbing problems: identify and correct flaws in the plumbing system.

STANDARD: Upon inspection, no flaws remained in the plumbing system.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A plumbing system with predetermined flaws, tools, supplies and equipment

PERFORMANCE GUIDE

1. Inspect plumbing system.
2. Identify flaws or problems areas.
3. Correct flaws using proper tools and procedures in:
   a. Copper pipe
   b. Galvanized pipe
   c. PVC pipe

LEARNING ACTIVITIES

1. Show diagram on trouble areas in a plumbing system.
2. Discuss different areas where problems may exist.
3. Invite plumbing inspector to speak on trouble shooting.
4. Emphasize the importance of safety when installing or repairing plumbing systems.
5. Set up project to demonstrate some of the problem areas.

RESOURCES

Blankenbaker. **Modern Plumbing**, pp. 215-237
Clifford. **Encyclopedia of Household Plumbing**
Local plumbing code
Local plumbing inspector

EVALUATION

Practical Application
Inspect, identify and correct all flaws in the plumbing system.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 95 CHECKLIST

TROUBLE SHOOTING PLUMBING PROBLEMS: IDENTIFY AND CORRECT FLAWS IN THE PLUMBING SYSTEM

STUDENT'S NAME ______________________

EVALUATOR'S NAME ______________________

DATE ______________________

DATE ______________________

DIRECTIONS TO STUDENT: Identify and correct flaws in the plumbing system. Follow all safety rules. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed to identify and correct flaws in the plumbing system. Observe student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Located all flaws		
2. Corrected all flaws		
3. Work was neat in appearance and cleaned up work area		

Suggested teaching time
2 periods

DUTY OR UNIT: REPAIR AND MAINTENANCE

PERFORMANCE OBJECTIVE V-TECS 96

TASK: Clear obstructions from lavatory drains.

STANDARD: A normal amount of water must flow through the lavatory drain.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Access to plumbing tools, equipment and supplies

PERFORMANCE GUIDE

1. Remove cleanout or drain stopper and check for obstruction. Remove any obstruction and check for proper drainage.
2. If problem is not solved, plug overflow opening with rag and force air and water through drain line with vacuum plunger.
3. If problem is not solved, rod out drain line with flexible cable and auger.
4. If limited amount of water is moving, pour caustic chemical into drain, using chemical manufacturer's instructions for proper application.
5. If problem still exists, disassemble, clean, and reassemble drain and P-trap.

LEARNING ACTIVITIES

1. Arrange for plumbing service technician to speak on drainage stoppage and how to correct this problem.
2. List areas in drain where problems may exist.
3. Show equipment used for unstopping clogged drains.
4. Set up project where this problem exists.
5. Demonstrate the use of the flexible auger and cable for unstopping drains.
6. Discuss these methods for unstopping drains.
    a. Force cup
    b. Caustic chemicals (CAUTION.)

RESOURCES

Blankenbaker. **Modern Plumbing**, p. 23
Barclay. **Residential Plumbing**, p. 107-B
Local plumbing code

EVALUATION

Practical Application
Remove obstructions from a lavatory drain so water will flow freely through the drain.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 100% accuracy.

PERFORMANCE OBJECTIVE V-TECS 96 CHECKLIST

CLEAR OBSTRUCTIONS FROM LAVATORY DRAINS

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Remove obstruction from lavatory drain so water will flow freely through the drain. Use proper tools and practice all safety rules.

DIRECTIONS TO INSTRUCTOR: Provide access to tools, equipment, and materials needed to clear obstruction from lavatory drain. Observe the student. Accuracy of 100% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Removed the clean out and checked for obstruction.		
2. Used proper cable and auger to remove obstruction from drain.		
3. Water flowed freely through the drain.		
4. Properly reinstalled clean out plug.		
5. Properly replaced fixture if removed.		
6. Cleaned work area and restored tools to proper place.		

Suggested teaching time
2 periods

DUTY OR UNIT: REPAIR AND MAINTENANCE

PERFORMANCE OBJECTIVE V-TECS 97

TASK: Remove obstructions from main drain lines.

STANDARD: The drain line must accommodate the normal amount of waste.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A power-operated sewer auger and a caustic chemical

PERFORMANCE GUIDE

1. Identify cleanout opening in drain line. If none exists, remove appropriate fixture.
2. Attach proper size bit on end of rod.
3. Insert bit and rod into fixture drain line.
4. Bend rod as required to reach obstruction.
5. Activate power auger. Clean line, removing auger and cleaning as necessary.
6. If roots are present in drain, replace drain line.
7. Run water through line.
8. Repeat process until line is cleaned.
9. Replace fixture.

LEARNING ACTIVITIES

1. Discuss methods for unstopping main drainlines.
2. Demonstrate equipment used for unstopping clogged drainlines.
3. List areas in drains where problems may exist.
4. Show diagram of blockage at the base of the stack.
5. Set up project where this problem exists.

RESOURCES

Clifford. **Encyclopedia of Household Plumbing**, pp. 20-22
Barclay. **Residential Plumbing**, p. 57-G

EVALUATION

Question

What are the steps in removing obstructions from main drain line?

Answer

1. Locate cleanout opening and remove plug.
2. Attach proper size bit to end of rod and insert into cleanout opening.
3. Activate power auger.
4. Run water through repeatedly until line is clean.
5. Replace cleanout plug.

PERFORMANCE OBJECTIVE V-TECS 97 continued

Practical Application
Remove obstructions from main drain lines.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with 100% accuracy.

PERFORMANCE OBJECTIVE V-TECS 97 CHECKLIST

REMOVE OBSTRUCTIONS FROM MAIN DRAIN LINES

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Remove an obstruction from a main drain line. Follow all safety rules. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to clogged drain line, tools, and proper equipment. Observe the student. Accuracy of 100% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Used proper size auger bit		
2. Located cleanout plug and removed		
3. Used power auger according to instructions		
4. Water flows freely through line		
5. Properly reinstalled cleanout plug		
6. Properly replaced fixture		

Suggested teaching time
2 periods

DUTY OR UNIT: REPAIR AND MAINTENANCE

PERFORMANCE OBJECTIVE V-TECS 98

TASK: Remove obstructions from water closet drains.

STANDARD: The water closet must flush without overflowing.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A vacuum plunger and flexible hand auger

PERFORMANCE GUIDE

1. Force water through the water closet drain using a vacuum plunger.
2. Flush water closet.
3. If problem still exists, rod out drain with flexible cable and auger.
4. Remove auger from drain, pulling obstruction with auger.
5. If obstruction cannot be removed with auger, pull water closet and remove obstruction from drain.

*6. Flush water closet with handful of toilet tissue to test flushing action.
*7. Clean and return all tools and equipment.
*8. Clean up work site.

LEARNING ACTIVITIES

1. Arrange project where obstruction exists in water closet drain.
2. Show diagram of possible areas where obstructions may collect.
3. Demonstrate the use of a power driven cable or auger for use in water closet drains.
4. Demonstrate how to remove obstructions from drain lines.
5. Demonstrate how to service and clean power-driven equipment.

RESOURCES

Blankenbaker. **Modern Plumbing**, p. 231
Barclay. **Residential Plumbing**, p. 107-B
Local plumbing code

EVALUATION

Question

What are the steps to unstopping a water closet drain?

Answer

1. Use vacuum plunger.
2. Rod out drain with flexible cable or auger.
3. Pull water closet and remove obstruction from drain.
4. Flush water closet with tissue to test flushing action.

*Steps determined as necessary by the South Carolina Curriculum Writing Team.

Practical Application
Remove obstructions from water closet drain by the use of flexible cable, auger, or caustic chemicals.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 98 CHECKLIST

REMOVE OBSTRUCTIONS FROM WATER CLOSET DRAINS

STUDENT'S NAME

EVALUATOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: Remove obstruction from water closet drain by the use of flexible cable, auger, or caustic chemicals.

DIRECTIONS TO INSTRUCTOR: Observe the student's performance. Be sure the student is using the proper tools for this task and also practices safety. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Located the obstruction in drain		
2. Analyzed the drain problem		
3. Removed the water closet tank lid		
4. Correctly used vacuum plunger		
5. Used auger if required		
6. Water closet flushed without overflowing		
7. Replaced fixture correctly		

Suggested teaching time
1 period

DUTY OR UNIT: REPAIR AND MAINTENANCE

PERFORMANCE OBJECTIVE V-TECS 99

TASK: Replace lavatory trap drains.

STANDARD: Time limit is 15 minutes. When completed, the lavatory trap must not leak.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: An adjustable jaw wrench and faulty lavatory trap

PERFORMANCE GUIDE

1. Disconnect slip-joint nuts at lavatory trap.
2. Replace lavatory trap using complete kit provided by manufacturer and other necessary materials.
3. Check for leaks.

LEARNING ACTIVITIES

1. Set up project with faulty lavatory trap.
2. Provide students with trap and necessary equipment.
3. List some prohibited traps.
4. Emphasize importance of proper types of tools for replacing a trap drain.
5. Demonstrate method for replacing trap.

RESOURCES

Blankenbaker. **Modern Plumbing,** pp. 169-170
Clifford. **Encyclopedia of Household Plumbing,** pp. 23-26
Local plumbing code

EVALUATION

Practical Application
Replace lavatory trap drain.

Method of Evaluating Practical Application
Use Checklist to determine if activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 99 CHECKLIST

REPLACE LAVATORY TRAP DRAINS

STUDENT'S NAME

EVALUATOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: Replace a faulty lavatory trap according to specifications. Trap must not leak. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to replace a lavatory trap drain. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Correctly removed lavatory trap.		
2. Properly installed new trap according to manufacturer's instructions.		
3. New trap doesn't leak.		
4. Completed work with in time limit of 15 minutes.		
5. Cleaned work area and properly stored tools.		

Suggested teaching time
2 periods

DUTY OR UNIT: REPAIR AND MAINTENANCE

PERFORMANCE OBJECTIVE V-TECS 100

TASK: Repair leaking shower valves.

STANDARD: When completed, the shower valve must not leak.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: An adjustable wrench, a valve seat wrench, and a leaking shower valve

PERFORMANCE GUIDE

1. Cut off water supply to valve.
2. Remove valve stem.
3. Remove valve seat using valve seat wrench and replace with new one.
4. Remove washer on end of stem and replace with new washer.
5. Reassemble stem in body of shower valve.

LEARNING ACTIVITIES

1. Have project set up with a leaking shower valve.
2. Demonstrate the removal of the stem.
3. Demonstrate removing and replacing valve seat.
4. Explain removing washer on end of stem.
5. Show how to reassemble stem and body of shower valve and check for leaks.

RESOURCES

Blankenbaker. **Modern Plumbing**, p. 175
Clifford. **Encyclopedia of Household Plumbing**, pp. 169-170
Local plumbing code

EVALUATION

Practical Application

Repair leaking shower valve.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 100 CHECKLIST

REPAIR LEAKING SHOWER VALVES

STUDENT'S NAME

EVALUATOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: Repair a leaking shower valve. The valve must not leak. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to leaking shower valve, tools, and supplies. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly cut off water supply		
2. Properly removed and replaced valve seat		
3. Properly installed new washer		
4. Properly reassembled shower valve		
5. Repaired valve functions properly and doesn't leak		
6. Cleaned tools and stored in proper place		

Suggested teaching time
2 periods

DUTY OR UNIT: REPAIR AND MAINTENANCE

PERFORMANCE OBJECTIVE V-TECS 101

TASK: Repair leaking water faucets or valves.

STANDARD: The faucet must not be marred by plumbing tools, and it must not leak after repair.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A strap wrench, screwdriver, knife, washers, a seat-dressing tool, and a leaking water faucet

PERFORMANCE GUIDE

1. Shut off water supply to faucet.
2. Turn faucet handle to open faucet.
3. Unscrew faucet cap, using a strap wrench.
4. Remove spindle to expose washer.
5. Remove brass center screw.
6. Lift washer with knife tip.
7. Replace washer with new one and tighten.
8. Replace packing washer between cap nut and spindle according to these steps.
    a. Remove cap nut and spindle.
    b. Remove handle from top of stem.
    c. Replace packing washer.
9. Dress faucet ground seat according to these steps.
    a. Insert seating tool in faucet and press threaded cone down into body opening.
    b. Center spindle and cutter in faucet.
    c. Using moderate downward pressure, rotate handwheel to right to dress seat.
10. Reassemble remaining parts.

LEARNING ACTIVITIES

1. Discuss how to repair a leaking water faucet.
2. Show how to use a strap wrench to unscrew faucet cap.
3. Demonstrate how to remove the brass center screw and rubber washer.
4. Demonstrate how to replace packing between cap nut and spindle.
5. Show how to dress faucet seat.
6. Emphasize the importance of properly reassembling parts.

RESOURCES

Clifford. **Encyclopedia of Household Plumbing**, pp. 91-96
Blankenbaker. **Modern Plumbing**, pp. 215-217
Barclay. **Residential Plumbing**, p. 27-G

PERFORMANCE OBJECTIVE V-TECS 101 continued

Practical Application
Identify steps in repairing a leaking water faucet or valve. Repair a leaking water faucet or valve.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 101 CHECKLIST

REPAIR LEAKING WATER FAUCETS OR VALVES

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Repair leaking water faucets or valves. Do not marr faucet with tools. The repair must not leak. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to repair a leaking water faucet or valve. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly shut off water supply		
2. Properly disassembled faucet		
3. Do not damage or scar faucet		
4. Properly dressed valve seat		
5. Properly replaced washer		
6. Properly reassembled faucet		
7. Faucet operated correctly and didn't leak		

Suggested teaching time
1 period

DUTY OR UNIT: REPAIR AND MAINTENANCE

PERFORMANCE OBJECTIVE V-TECS 102

TASK: Repair ball cock valve.

STANDARD: Repaired valve must not leak.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: Access to tools, equipment, and supplies

PERFORMANCE GUIDE

1. Shut off water at fixture cut off.
2. Remove tank top.
3. Check water level and flow.
4. Disassemble valve.
5. Check valve seat and washers.
6. Clean and smooth rough parts.
7. Replace valve seat and washer if needed.
8. Check for correct operation and leaks.

LEARNING ACTIVITIES

1. Discuss the correct operation of a ball cock valve.
2. Demonstrate disassembling of a ball cock valve.
3. Show how to check valve seat and washer.
4. Demonstrate cleaning and dressing rough parts.
5. Show how to replace valve seat and washer.

RESOURCES

Clifford. **Encyclopedia of Household Plumbing,** pp. 31-33
Blankenbaker. **Modern Plumbing,** pp. 222-224

EVALUATION

Practical Application

Repair ball cock valve.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 102 CHECKLIST

REPAIR BALL COCK VALVE

STUDENT'S NAME ______________ EVALUATOR'S NAME ______________

DATE ______________ DATE ______________

DIRECTIONS TO STUDENT: Repair a ball cock valve. Repaired valve must not leak. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to repair a ball cock valve. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Cut off shut-off valve to fixture and removed tank top		
2. Checked water level and flow		
3. Disassembled, cleaned, and smoothed rough parts of valve		
4. Replaced seat and washer in valve		
5. Turned water on and checked valve for proper operation and leaks		

Suggested teaching time
1 period

DUTY OR UNIT: REPAIR AND MAINTENANCE

PERFORMANCE OBJECTIVE V-TECS 103

TASK: Repair diaphram-type valve.

STANDARD: Diaphram-type valve on water closet must be repaired and operable.

SOURCE OF STANDARD: None given in catalog.

CONDITIONS FOR PERFORMANCE OF TASK: Necessary tools, equipment and supplies

PERFORMANCE GUIDE

1. Shut off water at fixture cut off.
2. Empty flush tank.
3. Remove tank lid.
4. Remove intake valve.
5. Reseat new washer.
6. Replace intake valve.
7. Turn on water.
8. Check for leaks.

LEARNING ACTIVITIES

1. Demonstrate cutting off water supply to fixture and emptying flush tank.
2. Show how to remove upper chamber of intake valve and diaphram-type washer.
3. Demonstrate how to replace washer and reassemble valve.
4. Show diagrams on diaphram-type valve.
5. Arrange for students to turn on water and check for leaks.

RESOURCES

Blankenbaker. **Modern Plumbing,** pp. 222-223

EVALUATION

Practical Application

Repair diaphram-type valve.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 103 CHECKLIST

REPAIR DIAPHRAM-TYPE VALVE

STUDENT'S NAME

EVALUATOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: Repair a diaphram-type valve on a water closet. Check for leaks. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to repair a diaphram-type valve. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Shut off water at fixture cut off		
2. Removed upper chamber of intake valve		
3. Removed rubber diaphram		
4. Checked diaphram for defects		
5. Checked by-pass tube		
6. Replaced faulty diaphram and reassembled valve		
7. Valve operated properly and did not leak		

Suggested teaching time
2 periods

DUTY OR UNIT: REPAIR AND MAINTENANCE

PERFORMANCE OBJECTIVE V-TECS 104

TASK: Install a prefabricated air chamber.

STANDARD: When completed, the air chamber should suppress all noise caused by water hammer. Joints must not leak.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: Access to tools, equipment, and supplies

PERFORMANCE GUIDE

1. Determine location of noise.
2. Obtain access to water supply line.
3. Determine size air chamber required for line.
4. Cut off water supply.
5. Cut line at point where chamber will be installed.
6. Install tee in cut line.
7. Install air chamber at most distant point of termination.
8. Turn water on and test for water hammer.

LEARNING ACTIVITIES

1. Explain purpose of air chamber.
2. Discuss proper size of air chambers.
3. Identify and discuss locations of air chambers.
4. Demonstrate installation procedures.
5. Show diagrams of prefabricated air chamber.

RESOURCES

Clifford. **Encyclopedia of Household Plumbing**, p. 66
Local plumbing code
Barclay. **Residential Plumbing**, p. 21-G

EVALUATION

Practical Application

Install a prefabricated air chamber. Check for leaks and noise.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 104 CHECKLIST

INSTALL A PREFABRICATED AIR CHAMBER

STUDENT'S NAME ______________________ EVALUATOR'S NAME ______________________

DATE ______________________ DATE ______________________

DIRECTIONS TO STUDENT: Install a prefabricated air chamber. Check for leaks and noise. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to install a prefabricated air chamber. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Found location of noise		
2. Determined size of air chamber needed		
3. Cut off water supply		
4. Installed air chamber in proper position and location		
5. All joints and connections didn't leak		
6. Checked for noise caused by water hammer		

Suggested teaching time
2 periods

DUTY OR UNIT: REPAIR AND MAINTENANCE

PERFORMANCE OBJECTIVE V-TECS 105

TASK: Replace pressure control switches on water pumps.

STANDARD: The new switch must function to provide an amount of water at a pressure level designated by the pump manufacturer.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A screwdriver, a set of open-end wrenches, and a malfunctioning pressure control switch on a pump

PERFORMANCE GUIDE

1. Remove cover from control switch.
2. Turn water on and check opening and closing of switch points.
3. If switch contacts do not disengage, replace switch as described in following steps.
4. Turn off power supply.
5. Disconnect wiring on switch, observing carefully correct location of wire leads on switch.
6. Remove switch from pump.
7. Install new switch on pump and connect wire leads on switch.
8. Turn on power supply and check operation of pump.

LEARNING ACTIVITIES

1. Discuss the importance of using safety precautions when installing an electrical pressure control switch.
2. Show diagrams of the pressure control switch.
3. Explain how to replace a switch if switch contacts do not disengage.
4. Discuss the operations of a pressure control switch.
5. Demonstrate installing pressure control switch according to manufacturer's specifications.

RESOURCES

Barclay. **Residential Plumbing**, p. 37-G
Manufacturer's specifications

EVALUATION

Practical Application
Replace pressure control switch on a water pump. Check pressure level.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 105 CHECKLIST

REPLACE PRESSURE CONTROL SWITCHES ON WATER PUMPS

STUDENT'S NAME

EVALUATOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: Replace pressure control switches on water pump. Check pressure level. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to replace a pressure control switch on a water pump. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Checked opening and closing of points		
2. Removed switch from pump		
3. Replaced switch		
4. All wiring was checked and tight		
5. Checked pump operation		

Suggested teaching time
2 periods

DUTY OR UNIT: REPAIR AND MAINTENANCE

PERFORMANCE OBJECTIVE V-TECS 106

TASK: Replace a section of galvanized water supply line.

STANDARD: The completed pipe joints must not leak.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A four-wheel cutter, pipe wrenches, pipe nipple, half unions, pipe vise, reamer, pipe sealant and pipe threaders, and a water supply line installed horizontally underneath a raised floor

PERFORMANCE GUIDE

1. Turn off water supply.
2. Cut pipe at desired location, using four-wheel cutter.
3. Remove pipe to be replaced from fitting, disconnecting hangers if necessary.
4. Assemble nipple and half union and connect to fittings in supply line.
5. Measure, cut, and thread replacement pipe, allowing for fittings.
6. Connect unions.
7. Turn on water supply and check for leaks.

LEARNING ACTIVITIES

1. Give lecture on replacing a section of galvanized water pipe.
2. Review the use of four-wheel cutters.
3. Explain why a union is being used to replace this section of pipe.
4. Demonstrate the proper use of tools to replace a section of galvanized pipe.
5. Review pipe threading procedure.

RESOURCES

Barclay. **Residential Plumbing,** p. 23-G
Local plumbing code

EVALUATION

Practical Application
Replace a section of galvanized water supply line. Check for leaks.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 106 CHECKLIST

REPLACE A SECTION OF GALVANIZED WATER SUPPLY LINE

STUDENT'S NAME ____________________ EVALUATOR'S NAME ____________________

DATE ____________________ DATE ____________________

DIRECTIONS TO STUDENT: Replace a section of galvanized water supply line. Check for leaks. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials for the student to replace a section of galvanized water supply line. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Cut off water supply		
2. Pipe was properly cut		
3. Properly threaded all pipe ends		
4. Properly tightened all joints and connections		
5. All joints and connections didn't leak		
6. Replaced all pipe hangers as needed		

Suggested teaching time
1 period

DUTY OR UNIT: REPAIR AND MAINTENANCE

PERFORMANCE OBJECTIVE V-TECS 107

TASK: Thaw frozen pipes.

STANDARD: Water must flow freely through the pipe after thawing.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: An exposed frozen steel water supply pipe, torch, and necessary materials

PERFORMANCE GUIDE

1. Locate frozen area of pipe.
2. Open faucet or valve.
3. Light torch and adjust flame.
4. Apply heat in a back and forth motion over entire length of freeze. Take precautions against fire.
5. Continue Step 4 until water runs freely through lines.
6. Remove torch and extinguish flame.
7. Allow water to flow for several minutes to avoid refreezing.
8. Close faucet or valve.

LEARNING ACTIVITIES

1. Provide a piping situation involving a frozen water pipe.
2. Discuss the steps in thawing water pipes.
3. Review lighting torch and adjusting flame.
4. Explain applying heat in a back and forth motion over entire length of freeze.
5. Emphasize safety precautions against fire.
6. Explain why water should flow several minutes after thawing pipes.

RESOURCES

Barclay. **Residential Plumbing**, p. 25-G
Clifford. **Encyclopedia of Household Plumbing**, p. 126

EVALUATION

Practical Application
Thaw frozen pipe. Follow all safety rules.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 107 CHECKLIST

THAW FROZEN PIPES

STUDENT'S NAME

EVALUATOR'S NAME

DATE

DATE

DIRECTIONS TO STUDENT: Thaw frozen pipes. Follow all safety rules. Clean work area and store tools properly.

DIRECTIONS TO EVALUATOR: Provide access to tools, equipment, and materials needed for the student to thaw frozen pipes. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Correctly located frozen area		
2. Opened valve or faucet		
3. Correctly lighted and adjusted torch		
4. Applied heat properly to frozen area		
5. Shut down torch properly		
6. Water flows freely through pipe		
7. Closed valve or faucet		
8. No damage done to pipes and surroundings		

ESTIMATING

Suggested teaching time
2 periods

DUTY OR UNIT: ESTIMATING

PERFORMANCE OBJECTIVE V-TECS 108

TASK: Compute the costs for plumbing supplies.

STANDARD: The total cost for piping, fittings and fixtures in the bathrooms and kitchen must be computed to be within ± $10 of the instructor's computation.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A blueprint, job specifications for a two-bath house, and materials cost sheets from a manufacturer

PERFORMANCE GUIDE
The instructor will indicate the starting point in the bathroom and kitchen. The student will make a materials list with prices and total the costs for materials.

LEARNING ACTIVITIES
1. Review how to take scale measurements from a blueprint.
2. Review how to convert scale measurements to full size.
3. Explain how to make these lists.
   a. D.W.V. piping
   b. D.W.V. fittings
   c. Water piping
   d. Water pipe fittings
   e. Fixtures
4. Show how to interpret supply house material cost sheets.
5. Invite a local contractor to demonstrate how their company estimates job materials and costs.

RESOURCES
Local contractor
Blankenbaker. **Modern Plumbing**, pp. 83-96

EVALUATION
Practical Application
Provided with blueprint, job specifications, and price list, compute the cost for a two and a half bath house. The instructor will provide this information.

Method of Evaluating Practical Application
Use Checklist to determine if the activity was completed with at least 90% accuracy.

PERFORMANCE OBJECTIVE V-TECS 108 CHECKLIST

COMPUTE THE COSTS FOR PLUMBING SUPPLIES

STUDENT'S NAME ______________ EVALUATOR'S NAME ______________

DATE ______________ DATE ______________

DIRECTIONS TO STUDENT: Compute the costs for plumbing supplies for a two-bath house. The evaluator will provide the blueprint, specifications, and cost sheets from a manufacturer.

DIRECTIONS TO EVALUATOR: Provide the student with blueprint, job specifications, and cost sheets from a manufacturer. Check the student's computations. Calculations must be within ± $10 of your figures.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Completed materials list		
2. Prices for materials are correct		
3. Calculations are correct and within ± $10 of instructor's figures		

Suggested teaching time
1 period

DUTY OR UNIT: ESTIMATING

PERFORMANCE OBJECTIVE V-TECS 109

TASK: Complete plumbing fixture and supplies inventory.

STANDARD: A manual inventory of necessary supplies and fixtures must be completed to the satisfaction of the instructor.

SOURCE OF STANDARD: V-TECS writing team, Mississippi

CONDITIONS FOR PERFORMANCE OF TASK: A storage area and necessary supplies and fixtures

PERFORMANCE GUIDE

*1. Arrange supplies into:
    a. D.W.V. groups
    b. Water system groups
*2. Group the fixtures together.
*3. Make lists of each number of different fittings, supplies and fixtures.
*4. Write the total number beside each list of items.

LEARNING ACTIVITIES

1. Review how to recognize D.W.V. and water pipe fittings.
2. Discuss ways of storing and labeling materials and fittings.
3. Prepare master list of the materials.
4. Calculate amount of materials:
    a. On hand
    b. Used
    c. On order
    d. To order
5. Reorganize existing inventory.

RESOURCES

Blankenbaker. **Modern Plumbing,** pp. 40-73, 167-179

EVALUATION

Practical Application

Using the school shop storeroom, take inventory of supplies and equipment.

Method of Evaluating Practical Application

Use Checklist to determine if the activity was completed with at least 90% accuracy.

*The Performance Guide was not given in the Catalog. The South Carolina Curriculum Writing Team determined these steps as necessary in order to complete the task.

PERFORMANCE OBJECTIVE V-TECS 109 CHECKLIST

COMPLETE PLUMBING FIXTURE AND SUPPLIES INVENTORY

STUDENT'S NAME ____________ EVALUATOR'S NAME ____________

DATE ____________ DATE ____________

DIRECTIONS TO STUDENT: Take a manual inventory of supplies and fixtures in the school shop.

DIRECTIONS TO EVALUATOR: Provide access to the school shop storeroom for the student to take a manual inventory. Observe the student. Accuracy of 90% is required.

ITEMS TO BE EVALUATED	SATISFACTORY	UNSATISFACTORY
1. Properly identified and checked all supplies and equipment		
2. Inventory was accurate and acceptable to instructor		

APPENDICES

APPENDIX A
Duties and Tasks

Duty/Task		Performance Objective	Page Number
I.	INTRODUCTION TO PLUMBING		
	Purpose of plumbing (list and describe).	V-TECS 1	6
	Plumbing safety	V-TECS 2	7
	Ethics of the plumbing industry	V-TECS 3	8
	Use of basic plumbing tools	V-TECS 4	10
	Reading a rule	V-TECS 5	11
	Use of basic materials and fittings	V-TECS 6	12
	Demonstrate the use of equipment or tools.	V-TECS 7	13
	Purpose of plumbing codes	V-TECS 8	14
	Uses of plumbing codes and local amendments	V-TECS 9	15
II.	BLUEPRINT READING		
	Identify symbols for plumbing fittings and fixtures.	V-TECS 10	17
	Sketch floor plan.	V-TECS 11	18
	Diagram drainage system.	V-TECS 12	20
	Diagram hot and cold water systems.	V-TECS 13	22
III.	PREPARATION AND JOINING OF PIPES		
	Bend copper tubing with spring bender.	V-TECS 14	25
	Cut cast-iron soil pipe with snap-type chain cutter.	V-TECS 15	28
	Cut copper tubing and pipe with hacksaw.	V-TECS 16	31
	Cut copper tubing and pipe with tubing cutter.	V-TECS 17	34
	Cut steel pipe with 4-wheel pipe cutter.	V-TECS 18	37
	Cut steep pipe with one-wheel cutter.	V-TECS 19	40
	Join cast-iron soil pipe, using lead and oakum.	V-TECS 20	43
	Join cast-iron pipe to clay pipe.	V-TECS 21	46
	Wipe clay pipe joints.	V-TECS 22	49
	Join clay pipe with couplings.	V-TECS 23	52

Join copper tubing to brass pipe. V-TECS 24 54
Join copper tubing/pipe to copper pipe/tubing. V-TECS 25 57
Join copper tubing/pipe to plastic pipe. V-TECS 26 59
Join copper tubing/pipe to plastic pipe, using sweat method. V-TECS 27 62
Join copper tubing to steel pipe. V-TECS 28 64
Join copper tubing with compression connectors. V-TECS 29 67
Join copper pipe using flare connectors. V-TECS 29-A 69
Join pipe with no-hub or band clamp couplings. V-TECS 30 72
Join plastic pipe to cast-iron with no-hub couplings. V-TECS 31 75
Join plastic pipe, using solvent cement method. V-TECS 32 77
Join plastic pipe to steel pipe. V-TECS 33 80
Join steel pipe to cast-iron pipe with no-hub couplings. V-TECS 34 83
Thread steel pipe with adjustable die. V-TECS 35 85
Thread steel pipe with non-adjustable die. V-TECS 36 88
Thread steel pipe with power-driven vise stand. V-TECS 37 90
Secure with hangers horizontal and vertical lines of pipe to masonry surfaces. V-TECS 38 92
Secure with hangers horizontal and vertical lines of pipe to metal surfaces. V-TECS 39 95
Secure with hangers horizontal and vertical lines of pipe to wood surfaces. V-TECS 40 97

IV. DRAINAGE AND VENTING SYSTEMS

Calculate the slope required for building sewer lines. V-TECS 41 100
Install drain pipe in trenches. V-TECS 42 103
Backfill trenches. V-TECS 43 106
Establish grade lines for installing plumbing. V-TECS 44 108
Lay out house drains. V-TECS 45 111
Install cleanouts on drains. V-TECS 46 113
Rough-in waste and vent lines for floor-mounted water closets. V-TECS 47 115

Rough-in waste lines for wall-mounted urinals.	V-TECS 48	118
Rough-in waste lines and vents for bathtubs.	V-TECS 49	120
Rough-in waste lines for shower baths.	V-TECS 50	123
Rough-in waste lines and vents for built-in lavatories.	V-TECS 51	125
Rough-in waste lines and vents for washer.	V-TECS 52	127
Rough-in waste lines and vents for kitchen sink.	V-TECS 53	129
Install grease interceptors in waste lines.	V-TECS 54	131
Install vent terminals (roof-flashing).	V-TECS 55	134
Make water tests on building drains.	V-TECS 56	136

V. WATER SYSTEMS

Determine point of entry of water lines.	V-TECS 57	140
Size water supply system.	V-TECS 58	143
Install cut-off valve in stop and waste box.	V-TECS 59	146
Install check valves on water feed lines.	V-TECS 60	150
Rough-in water supply lines for bathtubs.	V-TECS 61	153
Rough-in water supply lines for wall-mounted urinals.	V-TECS 62	156
Rough-in water supply lines for water closets.	V-TECS 63	158
Rough-in water supply lines for showers.	V-TECS 64	161
Rough-in water supply lines for kitchen sink.	V-TECS 65	164
Rough-in water supply lines for lavatories.	V-TECS 66	167
Rough-in water supply lines for washer.	V-TECS 67	170
Rough-in water supply lines for water heaters.	V-TECS 68	173
Make water pressure tests on water supply systems.	V-TECS 69	176
Insulate water lines.	V-TECS 70	180
Install water circulating pumps.	V-TECS 71	183
Install lawn sprinkler system.	V-TECS 72	186
Inspect plumbing system.	V-TECS 73	189

VI. PUMPS

Install a well pump.	V-TECS 74	193
Install a sump pump.	V-TECS 75	196

VII. DISPOSAL SYSTEMS

Install septic tank and drain field.	V-TECS 76	200
Make sewer tap in vitrified clay sewer pipe.	V-TECS 77	203
Classify public sewers.	V-TECS 78	206

VIII. INSTALLING FIXTURES

Install bathtubs.	V-TECS 79	208
Install flush valve-type water closets.	V-TECS 80	210
Install tank-type water closets.	V-TECS 81	212
Install built-in lavatories.	V-TECS 82	215
Install wall-mounted lavatories.	V-TECS 83	217
Install wall-mounted urinals.	V-TECS 84	220
Install shower bath accessories in ceramic tile baths.	V-TECS 85	222
Install kitchen sink.	V-TECS 86	224
Install garbage disposal units.	V-TECS 87	226
Install dishwashers.	V-TECS 88	228
Install drinking fountains.	V-TECS 89	230
Install pressure relief valves.	V-TECS 90	232
Install electric water heaters.	V-TECS 91	234
Install gas water heaters.	V-TECS 92	236

IX. HEATING SYSTEMS

Install water system components for hot water heating coils.	V-TECS 93	240
Install temperature and pressure relief valves on boilers.	V-TECS 94	243

X. REPAIR AND MAINTENANCE

Trouble shooting plumbing problems: identify and correct flaws in the plumbing system.	V-TECS 95	247
Clear obstructions from lavatory drains.	V-TECS 96	249
Remove obstructions from main drain lines.	V-TECS 97	251
Remove obstructions from water closet drains.	V-TECS 98	254
Replace lavatory trap drains.	V-TECS 99	257

Repair leaking shower valves.	V-TECS 100	259
Repair leaking water faucets or valves.	V-TECS 101	261
Repair ball cock valve.	V-TECS 102	264
Repair diaphram-type valve.	V-TECS 103	266
Install a prefabricated air chamber.	V-TECS 104	268
Replace pressure control switches on water pumps.	V-TECS 105	270
Replace a section of galvanized water supply line.	V-TECS 106	272
Thaw frozen pipes.	V-TECS 107	274

XI. ESTIMATING

Compute the costs for plumbing supplies.	V-TECS 108	277
Plumbing fixture and supplies inventory.	V-TECS 109	279

APPENDIX B
Definition of Terms

The following terms are supplied to establish operational definitions as they apply to this study.

CAREER LADDER: A vertical arrangement of jobs within an occupational area to indicate skill distinction and progression.

CATALOGS: A comprehensive collection of performance objectives, performance guides, criterion-referenced measures, and related data organized by a job structure or career ladder within a domain of interest.

CONSORTIUM: A group of state agencies, institutions, or other entities which have been legally constituted through letters of commitment, agreements, or by assignment of higher authorities to work together toward the solution of problems in education. A membership from autonomous agencies and institutions which cuts across state boundaries as they attempt to solve problems or meet goals.

D.O.T. CODE: A nine-digit number used to identify a specific job within a given domain.

INSTRUCTIONAL SYSTEM DEVELOPMENT (ISD): A deliberate, orderly process for planning and developing instructional programs which insures that personnel are taught the knowledge, skills, and attitudes essential for successful job performance. Depends on a description and analysis of the tasks necessary for performing the job, objectives, evaluation procedures to determine whether or not the objectives have been reached, and methods for revising the process based on empirical data.

OCCUPATIONAL INVENTORY (TASK INVENTORY BOOKLET): A survey instrument containing tasks performed by job incumbents within D.O.T.'s complete with background information and a list of tools and equipment.

PERFORMANCE-BASED INSTRUCTION: Instruction which, when properly designed and applied, results in the learner's demonstration of certain abilities. The desired abilities are selected before the instruction is designed and are clearly defined as observable performance objectives. In V-TECS catalogs, the abilities are primarily psychomotor. This type of instruction is also referred to as competency-based instruction.

PERFORMANCE GUIDE (PG): A series of steps, arranged in a sequence ordinarily followed, which when completed may result in the performance of a task. Also called "teaching steps."

PROJECT: An occupational domain area selected by a V-TECS member state for catalog development based upon the U.S. Department of Labor's Dictionary of Occupational Titles (D.O.T.).

STATE-OF-THE-ART (SOA STUDY): Research conducted to determine the current status of performance-based instructional materials and practices in the domain area under study and to obtain other information that might be useful in catalog development.

TASK: A unit of work activity which constitutes logical and necessary steps in the performance of a duty. A task has a definite beginning and ending point in its accomplishments and generally consists of two or more definite steps.

TASK ANALYSIS: A characteristic of a task statement which makes its accomplishments crucial to the acceptable performance of a worker or student. A method of analysis which identifies the critical tasks and aids in determining the consequence of poor performance or lack of performance by a worker or student.

WRITING TEAM: A team of people representing instructors with subject matter expertise, persons having knowledge and experience in developing criterion-referenced measures, and local or state supervisors of incumbent workers whose function is to analyze occupational data and develop performance objectives and criterion-referenced measures for specific D.O.T. areas.

APPENDIX C

Equipment by Percentage Rating

Equipment Description	Percentage of Members Using	Number of Members Using
Screwdrivers, Assorted	97.40	150
Hand Hacksaw	96.75	149
Pliers, Assorted	95.45	147
Wrenches, Assorted	95.45	147
Folding Rule	94.81	146
Chisels, Assorted	94.16	145
Hand Pipe Threaders	94.16	145
Hand Pipecutters and Reaming Tools	94.16	145
Ladders	94.16	145
Pipe-Threading Dies	94.16	145
Pipe Vise	92.86	143
Tube Cutter or Reamer	92.86	143
Files, Assorted	92.21	142
Portable Air or Electric Drills	92.21	142
Flaring Tool and Block	91.56	141
Shovels, Assorted	91.56	141
Plumb Bob	87.01	134
Hand Drills and Bits	86.36	133
Hand Saws	85.06	131
Caulking and Packing Irons	84.42	130
Pipe Taps	83.77	129
Retractable Steel Measuring Tapes	83.77	129
Plumber's Ladle	81.82	126
Punches, Assorted	81.82	126
Propane Torch	80.52	124
Portable Circular or Sabre Saws	78.57	121
Chalk Line	75.32	116
Spirit Level	72.08	111
Soldering Irons	71.43	110
Vacuum Plunger	71.43	110
Augers, Hand	70.78	109
Pedestal and Bench Grinders	69.48	107
Powered Pipe Cutters, Threaders and Reamers	68.18	105
Chain Vise	67.53	104
Portable Power Saws	66.88	103
Melting Furnace	66.23	102
Oxyacetylene Torch	65.58	101
Carpenter's Square	62.99	97
Hand Shears	62.99	97

Equipment Description	Percentage of Members Using	Number of Members Using
Scaffolds	61.04	94
Strap Wrench	60.39	93
Swaging Tools	59.09	91
Portable Grinder	57.79	89
Combination Square	55.84	86
Framing Square	55.84	86
Mattock Pick	55.84	86
Marking or Scratch Awls	52.60	81
Electric Arc Welder	50.00	77
Chain Tongs	45.45	70
Slings and Hoists	44.81	69
Power Rodding Equipment	44.16	68
Scriber	40.26	62
Hot Air Torch	39.61	61
Metal Scrapers	38.96	60
Personnel Hoists or Lifts	35.71	55
Transit and Tripod	35.06	54
Calipers	28.57	44
Circumference Rule	26.62	41
Dividers or Trammels	20.78	32
Inert-Gas Metal-Arc Welder	19.48	30
Orifice Meter	16.88	26
Bending Block and Pins	13.64	21
Total Respondents	154	

Tools and Equipment Added After Survey

Spring-Type Tubing Bender
Turnbuckles and Clamps
Joint Runners
Hammers, Assorted
Putty Knife
Air Compressor and Attachments
Test Pumps

APPENDIX D
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The Encyclopedia of Household Plumbing Installation and Repair. Martin Clifford, Drake Publishers Inc., 801 2nd Ave., New York, New York 10017.

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Additional Resources

Local plumbing code
Local safety supervisor
Local insulation contractor
Local utility company
Local plumbing inspector
Local well and pump contractor
Local mechanical code
Manufacturer's specifications
Manufacturer's catalogs
Local septic tank system contractor

APPENDIX E

Evaluation Questions

I. INTRODUCTION TO PLUMBING

V-TECS 1 1. When installing potable water piping, care must be taken to prevent possible __________ __________ which may cause disease and death.

V-TECS 1 2. What are the two major benefits of plumbing today?

V-TECS 2 3. All power tools must have __________ __________ __________ type cords.

V-TECS 2 4. Safety __________ must be worn when working with molten metals.

V-TECS 2 5. Never work higher than the second rung from the top of a ladder. (True or false)

V-TECS 3 6. Sold the following situation. A faucet has been repaired for a customer. Several weeks later the customer calls to say that it is leaking around the handle. The customer feels that the work was not completed on the first visit and the plumber should come back to finish the repair job at no extra expense. You explain that the customer only asked to have new washers and that the stem started leaking later. The customer, however, insists that you should have explained the situation in more detail and the repairs could have been made at that time. The customer is upset and you know something has to be done to keep your good reputation. What is the solution?

V-TECS 4 7. A plumb bob is used to measure the vertical depth of sewer inverts. (True or false)

V-TECS 4 8. Lead pots are made of __________ __________ and care should be taken not to drop them or breakage may result.

V-TECS 4 9. __________ __________ and not pliers should be used on chrome faucet parts.

V-TECS 4 10. A 24" pipe wrench is normally used on 1/2" galvanized fittings. (True or false)

V-TECS 5 11. How may 1/8"s are in 1"?

V-TECS 5 12. How many inches are in 2'6"?

V-TECS 5 13. There are 42" in 3'6". (True or false)

V-TECS 5 14. Which is larger--1/64" or 1/32"?

V-TECS 5 15. Which is less--6'5" or 65"?

V-TECS 6 16. ______________ connections are used to separate steel from copper.

V-TECS 6 17. Pipe dope is used to help solder flow into a copper joint. (True or false)

V-TECS 6 18. Cast-iron fittings are sometimes used on temporary installations so that they may be broken for quick dismantling. (True or false)

V-TECS 7 19. When using a level on a sewer line, the bubble should be towards the low end of the level. (True or false)

V-TECS 7 20. A __________ __________ cutter uses the brittle nature of cast iron to its advantage.

V-TECS 7 21. A monkey wrench is like a pipe wrench with _______ jaws.

V-TECS 7 22. A builder's level (transit) is used to establish _______________ ________.

V-TECS 8 23. Identify at least three reasons for the plumbing code.

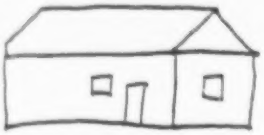
V-TECS 9 24. Which section of the plumbing code would explain the minimum size of a vent required for a water closet?
- a. General regulations
- b. Traps and cleanouts
- c. Plumbing fixtures
- d. Vents and venting

II. BLUEPRINT READING

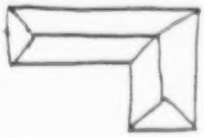
V-TECS 10 25. Draw the symbol for (1) a tank-type water closet, (2) a hot water pipe, and (3) a gate value.

V-TECS 11 26. Which of of the following drawings is the plan view of the house?

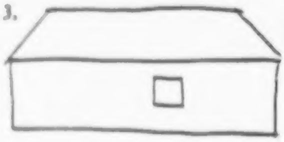
1.



2.



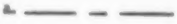
3.



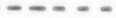
V-TECS 12 27. Why should plumbers avoid the use of "S" traps?

V-TECS 12 28. Which symbol is the vent?

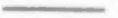
a.



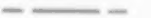
b.



c.



d.



V-TECS 13 29. How much cover should a buried water service supply pipe have to protect against freezing?

V-TECS 13 30. Why must parallel hot and cold water supply pipes be several inches apart?

III. PREPARATION AND JOINING OF PIPES

V-TECS 20 31. Why wear safety glasses when joining cast-iron soil pipe using lead and oakum?

V-TECS 20 32. Why should the ends be checked before joining cast-iron soil pipe?

V-TECS 20 33. What is cast-iron soil pipe made of?

V-TECS 20 34. How much space is left in hub of cast-iron soil pipe for lead?

V-TECS 20 35. Cast-iron soil pipe is used mainly for which part of the plumbing system?

V-TECS 21 36. Why should the bottom of the trench be well compacted?

V-TECS 21 37. Why is a level used on drainage pipes?

V-TECS 21 38. What are the advantages and disadvantages of clay pipe?

V-TECS 21 39. Why is the proper grade of clay pipe important?

V-TECS 21	40.	Why should the compound be beveled smoothly around the hub of cast-iron and clay pipe joint?
V-TECS 22	41.	Why should the clay pipe be inspected for holes and splits?
V-TECS 22	42.	How is terra cotta pipe made?
V-TECS 22	43.	Why is the spigot centered in center of bell when joining clay pipes?
V-TECS 22	44.	Why is a proper mixture of tar compound important when joining clay pipes?
V-TECS 22	45.	Why should spigot be all the way up into the bell when wiping joints?
V-TECS 23	46.	Why is lubricant spread on inside of clay pipe coupling?
V-TECS 24	47.	Why is it necessary to clean copper tubing?
V-TECS 24	48.	Why is flux applied to copper tubing and fittings?
V-TECS 24	49.	How do you know when solder has penetrated joint?
V-TECS 24	50.	Why do you need clean, sharp threads on brass pipe?
V-TECS 25	51.	What tool is used to cut hard copper tubing?
V-TECS 25	52.	How are the different weights of copper tubing identified?
V-TECS 26	53.	Why is it necessary to clean and square end of copper tubing?
V-TECS 26	54.	Why is flare nut put on copper tubing before flaring?
V-TECS 26	55.	How can you tell if end is flared correctly?
V-TECS 26	56.	Why is it necessary to have clean pipe and fittings in plastic pipe?
V-TECS 26	57.	Why is it necessary to twist plastic joint after assembling with glue?
V-TECS 28	58.	Why is it necessary to have clean, sharp threads on steel pipe?
V-TECS 28	59.	Why is necessary to use pipe joint compound on pipe threads?
V-TECS 28	60	What is the purpose of using a dielectric fitting in the connection?
V-TECS 29	61.	Why is it important to use adjustable wrenches on brass fittings?
V-TECS 29	62.	How tight should nuts be tightened on compression fittings?
V-TECS 29	63.	What keeps joint from leaking on compression fittings?
V-TECS 29-A	64.	Why inspect copper tubing for splits or cracks?
V-TECS 29-A	65.	Why is it important to use adjustable wrenches on flare connectors?
V-TECS 29-A	66.	Why do you ream copper tubing?
V-TECS 29-A	67.	Can you flare hard tubing? Why?
V-TECS 30	68.	Why do you cut cast-iron pipe ends square?
V-TECS 30	69	Wy should you wear safety glasses?
V-TECS 30	70.	Why do you position stainless steel shroud to cover gasket?
V-TECS 30	71.	Why should you use a torque wrench on no-hub band clamps?
V-TECS 30	72.	Why is it necessary to support cast-iron pipe securely?

V-TECS 31 73. Why is it necessary to use a special coupling when joining plastic to cast-iron soil pipe?

V-TECS 32 74. Why is it necessary to support plastic pipe securely?

V-TECS 32 75. Why is it necessary to inspect plastic pipe for smoothness and splits?

V-TECS 32 76. Why must plastic pipe be clean and free from dirt and grease?

V-TECS 33 77. What will happen if the plastic fitting is tightened on steel pipe too tightly?

V-TECS 33 78. Why do steel pipe threads need to be clean and sharp?

V-TECS 35 79. Why use cutting oil on dies?

V-TECS 35 80. Why is it necessary to check dies and tools?

V-TECS 35 81. How far should the pipe be threaded?

V-TECS 35 82. It is necessary to keep the floor clean of oil? Why?

V-TECS 38 83. Why does a certain pipe need a certain hanger?

V-TECS 38 84. Why should you wear and use safety equipment when installing hangers?

V-TECS 38 85. Why is it important to know how to measure and use a level when installing hangers?

V-TECS 38 86. Why is it important to be able to identify the different types of anchors?

IV. DRAINAGE AND VENTING SYSTEMS

V-TECS 41 88. What is the minimum slope per foot of a four-inch building sewer?

a. 1/16"
b. 1/4"
c. 1/8"
d. 1/2"

V-TECS 41 89. When installing a building sewer the plumber should take care to insure that the pipe is laid with a consistent _________ and free from _________.

V-TECS 42 90. What is the condition which causes the solids to settle to the bottom of a sewer line while the liquid flows off?

V-TECS 42 91. What precautions for safety must be taken when installing pipes in unstable ground?

V-TECS 43 92. Why must building sewers be carefully supported in ditches before backfilling is completed?

V-TECS 43 93. Care must be taken to prevent large ___________ from being dropped on sewer lines when backfilling is being started.

V-TECS 44 94. When roughed-in dimensions are being calculated, allowance must be made for finished ____________ thickness.

a. pipe
b. walls
c. foundations
d. ceilings

V-TECS 45 95. When plumbing systems are being roughed in under basement floors, what precaution must be taken if that floor is below the manhole cover in the street?

V-TECS 46 96. Cleanouts must be installed at or near the base of soil ______________ and at changes of directions greater than _______ degrees.

V-TECS 47 97. Why is it necessary to secure water closet floor flanges to the floor?

V-TECS 48 98. Urinals may be installed in a combination waste and vent system. (True or false)

V-TECS 49 99. What is the maximum vertical distance allowed between the bathtub waste outlet and the "P" trap?
- a. 2'
- b. 12"
- c. 3"
- d. 4'

V-TECS 50 100. What is the purpose of the waterproof membrane under a ceramic tile shower bath?

V-TECS 51 101. What is the drainage fixture unit discharge rating of a lavatory?

V-TECS 52 102. What is the minimum size waste pipe for a washing machine?

V-TECS 53 103. What is the minimum size vent permitted for a kitchen sink?

V-TECS 54 104. Grease interceptors should be placed in an _________ location for periodic removal of _____________ and routine maintenance.

V-TECS 54 105. Kitchen sinks in a restaurant must discharge through a _________ _________ before entering the sanitary sewer.

V-TECS 55 106. What is installed around a vent or soil stack where it penetrates a roof to make the roof weathertight?

V-TECS 56 107. How many pounds per square inch are exerted at the base of a soil stack filled with ten feet of water?

V-TECS 56 108. All plumbing must be tested when a building is completed. (True or false)

V. WATER SYSTEMS

V-TECS 57 109. Name at least three things to avoid when planning a route for a water line.

V-TECS 58 110. How much pressure is expected at the base of a column of water 1" x 1" x 12" high?

V-TECS 58 111. What is friction loss in a water supply system?

V-TECS 58 112. What size water supply pipes should the following fixtures have?
- a. Kitchen sink (domestic)
- b. Water closet (tank type)
- c. Water closet (flushometer valve)

V-TECS 58 113. What minimum size supply pipe should be run to a two bathroom dwelling?

V-TECS 59 114. How deep is the frost line?

V-TECS 59 115. Why is it important to tamp dirt back around the stop and waste box?

V-TECS 59 116. Why should care be taken not to overtighten a valve?

V-TECS 59 117. Which type of pipe should be used in acid soiled conditions?
- a. Galvanized iron
- b. Copper
- c. Plastic
- d. Black steel

V-TECS 60 118. What is the purpose of a check valve?

V-TECS 60 119. What happens when a check valve is not installed at the right angle?
- a. Increases pressure
- b. Decreases pressure
- c. Will not operate
- d. Creates turbulence

V-TECS 61 120. Why should outside walls be avoided when installing water pipes?

V-TECS 61 121. The hot and cold side of a tub/shower valve must be set back and equal distance from the finished wall. Explain why.

V-TECS 61 122. What should be done to prevent sheet rock nails from puncturing riser pipes.

V-TECS 61 123. Why must pipes be flushed out before screwing on the shower head outlet?

V-TECS 61 124. Why must there be an air gap between tub fill spout and the flood level rim?

V-TECS 63 125. Why is it better to bring the water supply piping to a water closet up through the wall instead of the floor?

V-TECS 63 126. What should be done to pipes when installing in an exterior wall?

V-TECS 63 127. It is not necessary to provide a shut-off valve under a water closet tank as the ball cock shuts off the incoming water. (True or false)

V-TECS 64 128. What is the purpose of an air chamber?

V-TECS 64 129 At which height should a shower mixing valve be installed?
- a. 2'6"
- b. 4"
- c. 5'6"
- d. 6"

V-TECS 65 130. How far apart should the hot and cold water lines to a kitchen sink be stubbed out of the wall?
- a. 4"
- b. 6"
- c. 8"
- d. 12"

V-TECS 66 131. Why should the water supply line ends be capped?

V-TECS 66 132. An air chamber greatly reduces water hammer under which conditions?

- a. The air in the chamber compresses the water.
- b. The air chamber expands letting the water expell inert gases.
- c. The air in the chambers is compressed by the water until equal to the shock wave.
- d. The air chamber overides the water pressure.

V-TECS 67 133. Why must the hot and cold water supply lines be flushed out before installing washing machines hoses?

V-TECS 67 134. What is the minimum size water supply to a washing machine?

- a. 3/8"
- b. 1/2"
- c. 3/4"
- d. 1"

V-TECS 69 135. Name at least two important reasons for applying a hydrostatic pressure test on a water supply system.

V-TECS 69 136. How might calculated air chambers affect a hydrostatic pressure test?

V-TECS 69 137. How much pressure should be applied when testing a potable water piping system?

V-TECS 69 138. Why is a water heater insulated?

- a. To prevent electrical shock
- b. To retard heat loss
- c. To prevent unnecessary heat in the kitchen
- d. To prevent condensation

V-TECS 70 139. Why is a chilled water line in a ceiling insulated?

- a. To stop it from freezing
- b. To slow down the corrosion process
- c. To prevent condensation
- d. To prevent against frostbite when touched

V-TECS 71 140. What is the purpose of a circulating hot water system?

V-TECS 71 141. Why should a gate valve be installed on each side of the pump?

V-TECS 71 142. What type of propulsion method does the centrifugal pump use?

- a. Single-action
- b. Double-action
- c. Duplex piston
- d. Impeller

V-TECS 71 143. A typical circulating pump is very efficient. (True or false)

V-TECS 71 144. Why are the working parts of a circulating pump built of brass or bronze?

V-TECS 72 145. Why is back siphonage/back flow protection needed on a lawn sprinkler system?

V-TECS 72 146. Why are manual drain valves installed at the low points of the sprinkler system?
- a. To prevent chemicals from entering the potable water supply
- b. To prevent the system from freezing
- c. So the sprinkler head can be adjusted
- d. To allow for thermal expansion

V-TECS 73 147. What is the minimum slope required on a 3" diameter building drain?

V-TECS 73 148. At what temperature should a T & P relief valve for a domestic water heater be set?

V-TECS 73 149. Where are cleanouts required in the horizontal drainage system?

V-TECS 73 150. At what height must a relief vent connect back into the stack vent?

VI. PUMPS

V-TECS 74 151. A reciprocating pump uses an impeller as its principle driving force. (True or false)

V-TECS 74 152. What is the maximum practical lift of a reciprocating pump?
- a. 20'
- b. 25'
- c. 34'
- d. 40'

V-TECS 75 153. What is the purpose of the float in a sump pump?

V-TECS 75 154. What precaution must be taken when connecting a sump pump discharge line into the sanitary drainage system?

VII. DISPOSAL SYSTEMS

V-TECS 76 155. Septic tanks should be located at least __________ from any well or other source of fresh water supply.
- a. 25'
- b. 50'
- c. 75'
- d. 100'

V-TECS 76 156. The most common gas formed in the decomposition of sewage is ________________.

V-TECS 76 157. Septic tanks are usually constructed of what material?

V-TECS 77 158. What is the best angle to tap into a main sewer?

V-TECS 77 159. What is the sand-cement ratio for applying to the sleeve connector?

V-TECS 77 160. A special precaution is needed when installing sewers in unstable ground conditions. What is this precaution?

V-TECS 77 161. Why must soil be put back carefully and tamped firmly?

V-TECS 78 162. What are the three basic shapes of intercepting sewers?

V-TECS 78 163. All trench shoring must be done with quality material free from ____________.

V-TECS 78 164. How do cities stop their intercepting sewers from becoming too deep in the ground when they are several miles long?

VIII. INSTALLING FIXTURES

None

IX. HEATING SYSTEMS

V-TECS 93 165. What are the two classes of hot water heating systems?

V-TECS 93 166. What is the purpose of an air vent in a hot water heating system?

V-TECS 94 167. What causes an explosion in a hot water system?

V-TECS 94 168. T&P valves should be opened occasionally by hand for what reason?

a. The boiler needs flushing out.
b. The valve spring should be stretched.
c. Corrosion may have made the valve inoperative.
d. The valve washers need to be dampened occasionally.

X. REPAIR AND MAINTENANCE

V-TECS 97 169. What are the steps in removing obstructions from the main drain line?

V-TECS 98 170. What are the steps to unstopping a water closet drain?

XI. ESTIMATING

None

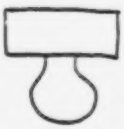
Evaluation Answers

I. INTRODUCTION TO PLUMBING

1. Cross connections
2. A good supply of potable water and a safe, efficient method of disposing of fecal matter and other synthetic unsanitary wastes are the benefits of plumbing.
3. Three wire grounded
4. Glasses
5. False
6. You offer to replace the stem for material and labor only (not the trip out) and ask if this would be satisfactory. You should have informed the customer of the worn stem and any other needed repairs discovered at the time of the first visit.
7. False
8. Cast iron
9. Adjustable wrenches
10. False
11. 8
12. 30"
13. True
14. 1/32"
15. 65"
16. Dielectric
17. False
18. True
19. False
20. Soil pipe
21. Smooth
22. Heights of piping or elevations of piping
23. 1. To insure structural soundness of buildings
    2. To protect public heath
    3. To insure a standard of workmanship
24. 4

II. BLUEPRINT READING

25. 1.



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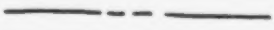

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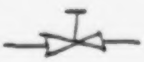

26. 2
27. "S" traps tend to induce syphonage which causes the trap to lose its water seal.
28. b
29. 18 inches for South Carolina
30. To stop heat transfer

III. PREPARATION AND JOINING OF PIPES

31. Safety glasses will protect the eyes.
32. Check ends for splits and sand holes.
33. Cast-iron soil pipe is made of pig iron and carbon in free state known as graphite.
34. One inch is left for lead.
35. It is used mainly for the drainage system.
36. Compact bottom of trench to keep pipe from setting.
37. To get proper sewage flow
38. The advantages of clay pipe are that it is impervious to liquids, resistant to acids, and will not corrode. The disadvantages of clay pipe are that it will settle and crack easily, allowing roots to grow in pipe.
39. Use the proper grade of clay pipe so sewage will not flow too slowly or too quickly and cause the pipe to stop up.
40. This process makes a flexible, watertight joint.
41. Some joints are cracked and will leak.
42. Terra cotta pipe is made of clay and cooked in ovens until vitrified pipe.
43. Pipe joint will be out of round and cause obstruction.
44. The mixture must be correct to seal the joint watertight.
45. This will keep oakum and compound from entering joint.
46. The pipe will join together more smoothly.
47. Clean oxidation and dirt off so that solder will stick.
48. Flux makes solder stick to tubing.
49. Solder will run into joint until full and then will drip off.
50. You need clean, sharp threads so that adapter will seat firmly and have a leak-proof joint.
51. Copper tubing cutter is used.
52. Color coding on the side of pipe identifies different weights of copper tubing.
53. Flared end is cleaned and squared so that it will be smooth and even.
54. It cannot be assembled after flaring.
55. The flared end will be smooth with no splits.
56. The fittings must be clean so that pipe and fittings will bond together with glue.
57. Glue will spread evenly on total area of joint.
58. This is necessary so pipe will make up properly without leaks.
59. Pipe joint compound will lubricate threads.
60. This will keep corrosion down between different metals.
61. Adjustable wrenches have smooth jaws. Pliers or pipe wrenches will scar or break wall of nut.
62. Tighten nut medium tight. It will crack if it is too tight.
63. Nut compresses sleeve against tubing and seals joint.
64. If tubing is split or rough, the joint will leak.
65. Adjustable wrenches have smooth jaws; pliers or pipe wrenches will scar nuts and mash.
66. Ream copper tiding to open end up and smooth end for flaring.
67. No, hard tubing is not designed to flare and will split on ends.
68. Pipe ends are cut square so pipe will be uniform and straight.
69. Pipe can break while being cut and could injure the eye.
70. It is positioned to fit squarely and eliminate leaks.

71. If tightened too tight, threads will strip and cause leaks.
72. Cast-iron is heavy and will leak in joint if moved out of place.
73. A special coupling must be used to avoid an eccentric connection.
74. Pipe is light and will move easily and cause joint to leak.
75. Sometimes they are out of round and split. This will cause a leak.
76. Cement will not stick to dirty pipe.
77. The fitting will split, causing a leak.
78. The plastic and steel pipe will not have good connection.
79. Dies will overheat and tear threads on pipe.
80. Check for broken teeth and worn blades.
81. Thread pipe one or two threads beyond face of bit.
82. Yes, because the operator could slip on the oil and be injured.
83. All hangers will not work on all types of pipe.
84. Working on ladders and overhead is dangerous.
85. You must be able to level pipes and space hangers correctly.
86. This will enable you to allow for the different kinds and types of pipes and methods of anchoring or attachment.
87. All hangers can not be used on all surfaces. Wood, metal and masonry surfaces each require specific hangers.

IV. DRAINAGE AND VENTING SYSTEMS

88. c
89. Slope, sags
90. The condition is an excessive slope or pitch.
91. The ditch must be supported by bracing or shoring.
92. Building sewers must be carefully supported to prevent uneven settling of the sewer.
93. Rocks
94. Walls'
95. A backwater valve must be installed to guard against reverse flow of sewage.
96. Stacks, 45
97. The hangers must be secured to prevent movement of the water closet after installation.
98. False
99. I
100. The purpose is to catch any water that leaks through the grout joints and carry it to the drain.
101. The rating is one d.f.u.
102. 2"
103. The minimum size permitted is 1¼".
104. Accessible, grease
105. Grease interceptor
106. A roof flashing is installed.
107. The amount exerted is 4.34 pounds per square inch.
108. False; testing must be done before pipes are concealed inside walls.

V. WATER SYSTEMS

109. You must avoid gas mains, power lines, sewer lines, trees, and other water lines.
110. Pressure needed is .434 lb.

111. Friction loss is loss of water pressure due to the resistance of water rubbing against the interior walls of pipes.
112. a. 1/2"
  b. 3/8"
  c. 1"
113. 3/4"
114. Locality will determine frost line. South Carolina requires 18 inches.
115. a. The dirt may settle later exposing pipe to freezing conditions.
  b. This could be a possible hazard to pedestrians.
  c. This situation could be unsightly.
116. Metal may be stretched which could cause a leak.
117. c
118. It prevents fluids from flowing in the wrong direction.
119. c
120. Avoid outside walls to protect the pipes from freezing.
121. This distance is necessary so that the trim will fit against the finished wall and have a neat appearance.
122. a. Install pipes in center of wall.
  b. Install protector plates in front of pipes.
123. Flush pipes to remove flux and solder and other particles from the pipes. This will avoid stopping up the outlet holes.
124. There must be an air gap to protect against a possible cross connection by back siphonage.
125. a. The floor is easier to install.
  b. Bathroom floor is easier to clean.
126. They should be insulated for protection.
127. False
128. The purpose of an air chamber is to prevent water hammer.
129. b
130. c
131. Water supply lines should be capped for testing by pressure.
132. c
133. Lines must be flushed out to prevent trash from blocking the mesh screen and solenoid valve in the washing machine.
134. b
135. a. To check for leaks
  b. Customer protection
  c. Certify plumbing installation
136. They may trap air and give a false pressure reading.
137. Apply at least as much pressure as the normal working pressure of the completed system.
138. b
139. c
140. A circulating hot water system provides a constant source of hot water throughout a building.
141. This procedure will isolate the pump for maintenance.
142. d
143. False
144. Brass or bronze will resist corrosion.
145. This protection is needed to prevent backflow of fertilizer and chemicals into the potable water supply.
146. b
147. The minimum slope is 1/8" per foot.

148. Set the value at 210oF.
149. Cleanouts are required at changes of direction greater than 45o.
150. The connection must be at a minimum of 6" above the flood level rim of the highest fixture on the stack.

VI. PUMPS

151. False
152. 25'
153. When the water level rises in the sump, it raises the float which activates the pump motor switch.
154. A check valve must be installed in the discharge line to prevent the reverse flow of sanitary drainage waste into the sump.

VII. DISPOSAL SYSTEMS

155. b
156. Methane
157. Concrete is used in septic tanks.
158. 45o
159. The ratio is two parts sand to one part portland cement.
160. The ditches must be sloped or supported by bracing.
161. Soil must be replaced correctly to avoid breaking the clay pipe and to stop it from settling unevenly.
162. The basic shapes are round, oval, and ovoid.
163. Defects
164. Occasional pumping at sewage lifting stations brings the sewage back up close to ground level.

VIII. INSTALLING FIXTURES

None

IX. HEATING SYSTEMS

165. The two systems are gravity systems and forced circulation systems.
166. The air vent releases trapped air from the high points in the system to allow the unrestricted circulation of the hot water.
167. An explosion is caused by the overheated water suddenly expanding to steam when exposed to atmospheric pressure.
168. c

X. REPAIR AND MAINTENANCE

169. 1. Locate cleanout opening and remove plug.
     2. Attach proper size bit to end of rod and insert into cleanout opening.
     3. Activate power auger.
     4. Run water through repeatedly until line is clean.
     5. Replace cleanout plug.
170. 1. Use vacuum plunger.
     2. Rod out drain with flexible cable or auger.
     3. Pull water closet and remove obstruction from drain.
     4. Flush water closet with tissue to test flushing action.

XI. ESTIMATING

None